Logix® TC-2000 Dual Stage Process Controller Operation and Installation Manual

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Safety Notification

Important Safety Considerations

It is very important for the user to consider the adverse effects of power, wiring, component, sensor, or software failures in designing any type of control or monitoring system. This TC-2000 Process Controller is not designed for applications in which a malfunction of the Process Controller could result in a hazardous and or dangerous condition. In no circumstance may this Process Controller be used to limit any piece of equipment to a safe mode of operation. This is especially important where economic loss or human life is involved. It is important that the user employ satisfactory overall system design. It is agreed between the buyer and Logix that this is the buyer's responsibility. It is the responsibility of the installer to ensure that the installation is in compliance with all national and local codes. Installation should only be attempted by a licensed electrician familiar with codes, standards, and proper safety procedures for line-voltage installations.

Caution: Read this Entire Document Prior to Installation and Operation of this Unit.

Warning: Risk of Electrical Shock. Severe injury or death can result from electric shock during contact with line voltage wiring and equipment. Disconnect and lock-out all power sources during installation and service.

TC-2000 Process Controller Description

The TC-2000 Process Controller is a rugged two-stage On/Off process controller featuring data communications monitoring, control and access with a Logix® Industrial Control System or monitoring and setpoint access with a standard PC. The unit is housed in a water-tight Type 4X rated enclosure suitable for washdown and outdoor locations. Additional features include independently adjustable setpoints and separate relay outputs. Each stage is configurable for operation in the Cooling or Heating mode. High and Low temperature alarms providing a visual warning (flashing display) if the process temperature exceeds either of the alarm setpoints. Additionally, the second relay output can be configured as an alarm output allowing direct control of an external alarm horn or beacon. The controller comes complete with a reliable highly accurate solid-state temperature sensor encased in a stainless-steel probe with eight feet of cable. An optional second temperature sensor is available which allows split temperature monitoring and control. Also, a user field "scratchpad" setpoint is provided allowing computer access to field entered information (e.g. specific gravity).

Button Functions

On/Off button - used to activate and deactivate the controller. When deactivated, the controller enters the standby mode and both output relays are de-energized but **power is not removed from the controller**.

Arrow buttons - used to adjust setpoints and other operating parameters when configuring the controller. During normal operation, pressing and holding the ▲ up arrow button will display the Stage 1 control Setpoint (Stage 1 LED will also illuminate). Pressing and holding the ▼ down arrow button will display the Stage 2 control Setpoint (Stage 2 LED will also illuminate). Pressing and holding both the ▲ up and ▼ down arrow buttons will display the second temperature (for Dual sensor controllers only).

Set button - used to access configuration setpoints and other operating parameters. This button can be locked out. Refer to **Locking the Set Button** below.

Display Functions

Temperature Display - displays actual temperatures during normal operation. While in standby, the message "Stop" is displayed. During configuration, setpoint temperatures, prompts and parameter values are displayed.

Stage 1 and 2 LEDs - used to indicate the on/off state of each output relay during normal operation. During configuration, the LEDs indicate which stage is being configured.

Remote LED - used to indicate the TC-2000 is integrated, monitored and *controlled* remotely by a Logix® Industrial Control System.

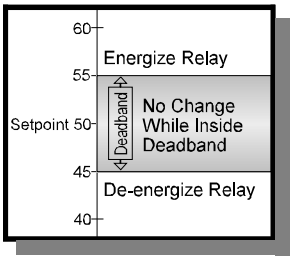
Network LED - used to indicate network communications activity between the TC-2000 controller and a Logix® Industrial Control System or a standard PC (requires optional TankView™ PC software).

Controller Operation

Activating and De-activating the Controller - pressing the **On/Off** button will toggle between the Automatic and Standby modes of operation. The **On/Off** button has a short delay built into it and must be held briefly to toggle the mode - this prevents inadvertent mode changes. **If power is removed and then reapplied to the controller, it will return to the operating mode it was in prior to the power removal.**

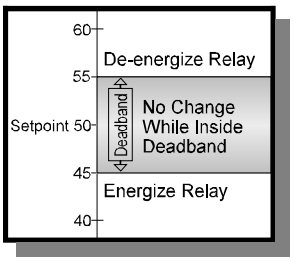
Viewing the Current Setpoint - while the controller is in the normal operating mode (not configuration), pressing the ▲ up arrow button will cause the stage 1 setpoint to be displayed as well as lighting the Stage 1 LED. Pressing the ▼ down arrow button will cause the stage 2 setpoint to be displayed as well as lighting the Stage 2 LED. When the button is released, the display will revert back to the current temperature.

Stage 1 and Stage 2 Operation Stage 1 and Stage 2 can be independently set for either cooling or heating mode (see configuration, below). Each stage has both a temperature control *setpoint* as well as a control *deadband*. The control deadband prevents excessive output relay cycling by creating a "dead" control zone *centered* around the control setpoint. No control change occurs while the temperature is inside of the control deadband. A typical mechanical thermostat has a 5°F deadband while the TC-2000 deadband can be adjusted anywhere between 0° and 50°F.



Cooling Mode Diagram

Cooling Mode - in the cooling mode, the relay output will de-energize when the process temperature falls *below* the temperature setpoint *less* one half of the deadband setpoint. Once the process temperature rises *above* the temperature setpoint *plus* one half of the deadband setpoint the output relay will energize.



Heating Mode Diagram

Heating Mode - in the heating mode, the relay output will energize when the process temperature falls *below* the temperature setpoint *less* one half of the deadband setpoint. Once the process temperature rises *above* the temperature setpoint *plus* one half of the deadband setpoint the output relay will de-energize.

During normal operation, whenever a Stage 1 or Stage 2 output relay is energized the respective Stage 1 or Stage 2 LED will be illuminated.

High and Low Temperature Alarm - The high and low alarm functions provide a visual warning. The temperature display will flash on/off if the process temperature exceeds the High Temperature Alarm setpoint or falls below the Low Temperature Alarm setpoint. The flashing alarm indication will automatically reset when the process temperature returns to normal. Stage 2 can also be configured as an alarm output (see Controller Configuration). When configured as an alarm, any alarm condition will energize the stage 2 control relay output. The alarm output can be "silenced" or de-energized by pressing either the up or down key.

Differential Control - The TC-2000 dual sensor controller can be configured to control Stage 2 based on the difference (differential) between sensor one and sensor two. To enable differential control, set the Stage 2 Mode setting to dIF and set the Stage 2 Control Setpoint to the difference between sensor measurements (specifically, Sensor 2 minus Sensor 1). For example, if the Stage 2 Control Setpoint is set at 5°F, the Stage 2 Deadband is set at 4°F and Sensor 1 measures 50°F, the Stage 2

output relay will energize when Sensor 2 measures above 57°F (55°F + ½ of 4°F). The Stage 2 output relay would de-energize when Sensor 2 measures below 53°F (55°F - ½ of 4°F). A negative Setpoint would energize when Sensor 1 exceeds Sensor 2.

Controller Configuration

All "programming", including changing setpoints, is performed in the Configuration Mode. To enter the Configuration Mode press the **Set** button, the **SP1** prompt appears. Both output relays remain de-energized during configuration. Use the▲ up or▼ down arrow buttons to change the displayed parameter value. Press and hold the▲ up or▼ down arrow buttons to rapidly advance the parameter. Press the **Set** button again move to the next parameter (you may scroll through each configuration parameter by repeatedly pressing the **Set** button). Pressing the **On/Off** button will exit the configuration mode.

All configured values are stored in non-volatile (permanent) memory and will be retained for a minimum of 10 years without power. No batteries are required.

Configuration Steps

When changing a setpoint value, then new value is saved when the **Set** button is pressed. **If no buttons are pressed within 30 seconds the controller will save all new values and exit the Configuration mode automatically.**

Step#	LED Prompt	Parameter	Adj Range	Default
1	SP1	Stage 1 Control Setpoint	-20°F to +200°F (-29°C to +121°C)	70.0°F
2	db1	Stage 1 Deadband	0 to 30°F (0°C to 17°C)	5°F
3	STG1	Stage 1 Mode	HEAT or COOL	COOL
4	SP2	Stage 2 Control Setpoint	-20°F to +200°F (-29°C to +121°C)	80.0°F
5	db2	Stage 2 Deadband	0 to 30°F (0°C to 17°C)	5°F
6	STG2	Stage 2 Mode	HEAT, COOL, ALA = Alarm, dIF = Differential (Dual Sensor Configuration Only), OFF=disabled	OFF
7	ALH1	High Temp Alarm Setpoint	-20°F to +200°F (-28°C to +121°C) & OFF	OFF
8	ALL1	Low Temp Alarm Setpoint	-20°F to +200°F (-28°C to +121°C) & OFF	OFF
9	ALH2	High Temp Alarm Setpoint 2 (Dual Sensor Configuration Only)	-20°F to +200°F (-29°C to +121°C) & OFF	OFF
10	ALL2	Low Temp Alarm Setpoint 2 (Dual Sensor Configuration Only)	-20°F to +200°F (-29°C to +121°C) & OFF	OFF
11	ALd	Alarm on differential (Dual Sensor Configuration Only)	-200°F to +200°F (-110°C to +110°C) & OFF	OFF
12	AdEL	Alarm Time Delay	In 10ths of minutes, 0 to 1000 minutes.	0
13	FLd	User field scratchpad	-1000 to +1000	0
14	Unit	Display Units, °F or °C, Whole or Tenths	F = °F Whole Units, F.0 = °F in Tenths, C = °C Whole Units, C.0 = °C in Tenths,	°F Whole Units
15	Loc	Configuration Lock	On or OFF	OFF
16	Addr	Datacomm Address	0 (disabled) to 255	255
17	SPd	Datacomm Speed	9600, 19.2K 38.4K or 115.2K BPS	9600 BPS
18	CAL1	Sensor 1 Calibration	Offset -30°F to +30°F (-17°C to +17°C)	0.0°F
19	CAL2	Sensor 2 Calibration (Dual Sensor Configuration Only)	Offset -30°F to +30°F (-17°C to +17°C)	0.0°F

Locking the Set Button

The **Set** button can be disabled to prevent tampering by unauthorized persons by setting the "Loc" function to On. To access the Configuration mode when the **Set** button has been locked, the controller must first be Deactivated using the **On/Off** button, then re-activated while holding the **Set** button. When the controller is activated, the "SP1" prompt will be displayed indicating that it is in the Configuration mode. After leaving the Configuration mode the **Set** button will remain locked unless the "Loc" parameter was changed to "OFF".

Note that the User Field Scratchpad “FLd” parameter can not be locked out. If the **Set** button is pressed when the “Loc” function is set to On, only the “FLd” configuration prompt will be displayed allowing modification to the User Field Scratchpad.

Setting Factory Default Setpoints

To change all setpoints back to the factory defaults settings first place the TC-2000 into Standby. Next press and hold Set, Up and Down keys together and then press the On key for 5 seconds. The phrase “dFLT” will appear indicating the default procedure is complete.

Controller Diagnostics

The controller continuously checks for internal errors. Should an error occur, both output relays shall de-energize (except if Stage 2 is configured as an Alarm “ALA” output in which case it will be energized) and one of the following error message will be displayed:

Description	Error Message
Sensor Fault	Prb1 or Prb2
Microcontroller internal error	Err1
Stuck Key	Err2

Controller Installation

Warning: Risk of Electrical Shock. **Multiple sources** of electrical power may exist in this enclosure. To prevent possible electrical shock or equipment damage, disconnect all sources electrical power to the unit before and during installation. **DO NOT** restore electrical power to the unit until the controller is properly installed and the cover is securely in place. **DO NOT** operate this unit if it becomes damaged in any way or if it the enclosure contains water. Verify all connections are secure, fused and properly terminated before applying power the controller.

Caution: Tighten Controller line-voltage electrical connections to 12 Lb-In of torque. Use minimum #14AWG 60°C stranded copper conductors only.

Caution: Do NOT drill holes or cutouts anywhere in the enclosure except the bottom wall (the bottom wall is where the factory ½" conduit hole and sensor cable fitting is located). Drilling holes or fabricating cutouts anywhere in the enclosure except the bottom wall may create an unsafe condition and will VOID THE WARRANTY. If unsure of this requirement, contact your TC-2000 supplier for more information.

Preparation

Read this entire manual prior to installation to avoid unnecessary problems. If the Controller computer network is to be wired, it is more convenient to drill the additional cable /conduit fitting holes before mounting the enclosure. Do NOT use a twist-type drill bit to fabricate holes as they will not drill smooth holes and may damage the Controller enclosure. A hole saw or step-bit will give satisfactory results. Refer to the *Network Cable Fitting Locations* drawing below.

Enclosure Mounting

Select a mounting location allowing unencumbered and convenient access to the controller. The controller should be mounted in a location without direct exposure to sunlight. Loosen the four (4) large plastic cover screws and carefully remove the cover. Unplug the interconnect wire harness from the Power/Relay circuit board located in the enclosure *base*. Allow the cover to hang from the sensor wires while mounting the enclosure. Be careful not to damage the sealing edge of the enclosure walls. Mount the controller to a flat vertical surface using four (4) suitable #8 stainless-steel screws (not supplied). Use the existing enclosure mounting holes, which are external to the equipment cavity and located under the large cover screw threaded holes at each corner.

Conduit Hubs and Fittings

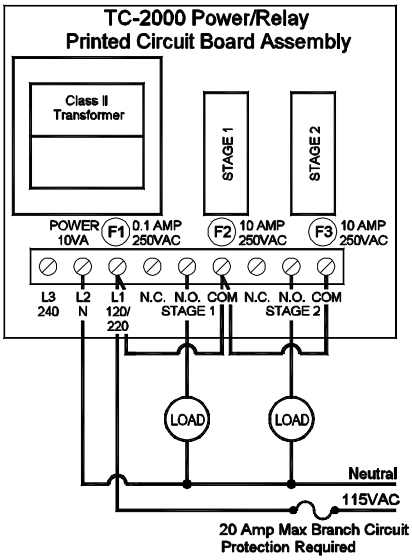
The controller is supplied with hole suitable for a ½" conduit fitting. A conduit hub or fitting designated as type 4X "Liquid Tight" must be utilized in order to maintain the watertight integrity of the enclosure. Conduit hubs must be connected to the conduit before the hub is connected to the enclosure. Under no circumstances can low voltage (network/sensor) wiring and line voltage control wiring be combined inside the same conduit.

Caution: This enclosure is non-metallic and does NOT provide a grounding means between conduit connections. Use of grounding hubs and jumper wires is required.

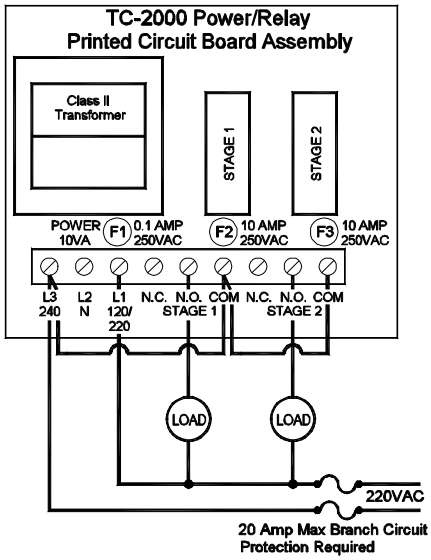
Control Wiring

Loosen the four (4) large plastic cover screws and carefully remove the cover. If not done so already, unplug the interconnect wire harness from the Power/Relay circuit board located in the enclosure *base*. Allow the cover to hang from the sensor wires while the control wiring is being done. Be careful not to damage the sealing edge of the enclosure walls. All of the line voltage wiring is done to the Power/Relay circuit board located in the enclosure *base*.

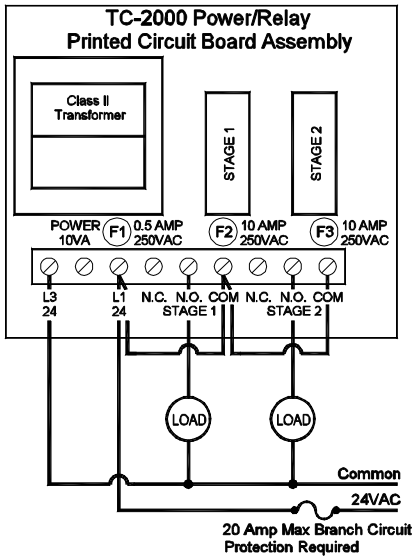
All wiring should be performed by a qualified electrician following the National Electric Code and local regulations. Use stranded copper conductors only. The total electrical load must not exceed the rating of the controller (see specifications). Twenty (20) ampere maximum branch circuit protection is required for both the controller power and relay contact circuits. The relay contact circuit can be combined with or be independent of the controller power circuit. Multiple TC-2000 controllers may share power and relay circuits.



115VAC Field Wiring Diagram
Model TC-2000-120/240



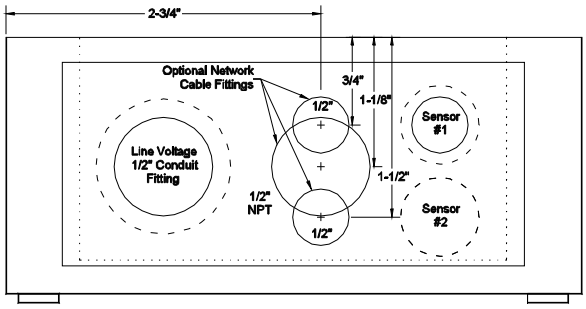
220VAC Field Wiring Diagram
Model TC-2000-120/240



Low Voltage 24VAC Field Wiring
Diagram Model TC-2000-24

TC-2000 Control Electrical Wiring Diagrams

Network Wiring

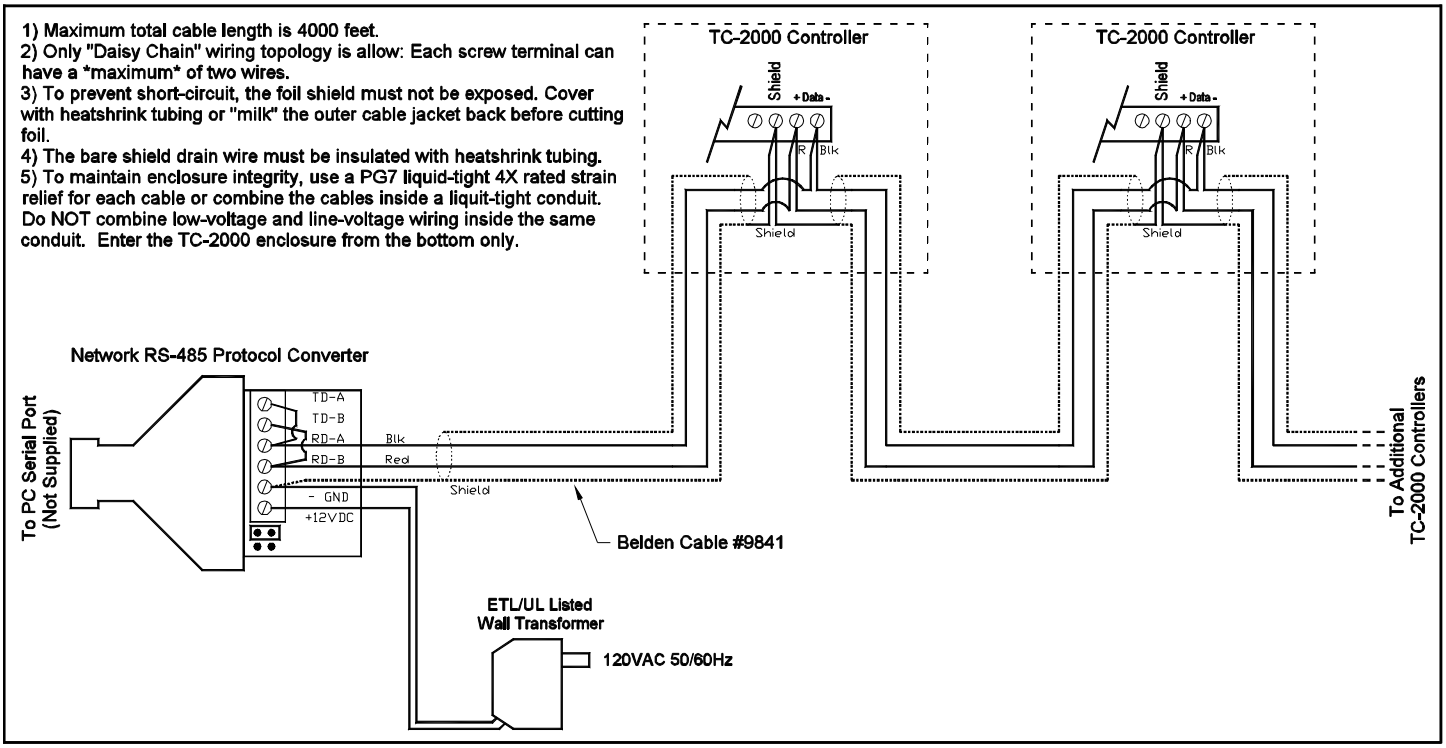


TC-2000 Bottom View

Network Cable Fitting Locations

To maintain enclosure watertight integrity, the low-voltage network cable(s) must either be placed inside a separate low-voltage-only 4X liquid-tight rated ½" conduit or be secured with a PG7 type 4X liquid-tight rated strain relief (one for each cable). Under no circumstances can low voltage (network/sensor) wiring and line voltage control wiring be combined inside the same conduit. It is more convenient to drill the additional cable/conduit fitting holes before mounting the enclosure. Do NOT use a twist-type drill bit to fabricate holes as they will not drill smooth holes and may damage the Controller enclosure. A hole saw or step-bit will give satisfactory results.

Remove all power sources before opening the TC-2000 enclosure. The network wiring connections are made to the display circuit board mounted in the enclosure *cover*. Carefully follow the wiring diagrams shown below when connecting the network. The network cable must "daisy-chain" from controller to controller with the last controller having a only single cable attached. No more than two (2) network cables are allowed inside any controller box. **Any other configuration will NOT function correctly.**



Network Wiring Diagram

Final Inspection and Cover Reassembly

Verify all wiring with wiring diagrams. Confirm there are no loose strands of wire or exposed shielded cables. Carefully insert the interconnect wire harness plug into mating socket located on the Power/Relay circuit board. Reinstall the cover while verifying all cables and wires are completely within the enclosure and are not interfering with the enclosure seal. Carefully tighten the four (4) large plastic cover screws evenly. Do not over tighten.

Sensor Wiring

The temperature sensor probe assembly is pre-wired at the factory. The temperature sensor probe wiring connections are made to the display circuit board mounted in the enclosure *cover*. If sensor removal or replacement is required, be sure to follow the wire color designations printed on the circuit board when reconnecting the sensor.

TC-2000 Specifications

Power Requirements	
Model TC-2000-120/240:	115/220VAC ±15% 50/60Hz 10 VA Max. Fuse F1: 0.1 Amp Fast-Acting 250VAC 5x20mm, Wickmann 193-0100 or equal.
Model TC-2000-24:	24VAC ±15% 50/60Hz 10 VA Max. Fuse F1: 0.5 Amp 250VAC Fast-Acting 5x20mm, Wickmann 193-0500 or equal.

Stage 1 & 2 Output SPDT Relay Ratings							
	115VAC		208/220VAC		24VAC		Fuse F2 and F3: 10 Amp Time-Delay 250VAC 5x20mm, Wickmann 181-2100 or equal
	N.O.	N.C.	N.O.	N.C.	N.O.	N.C.	
Resistive/GP Amps:	10.0	6.0	5.0	3.0	10.0	6.0	
Full-Load Amps:	9.8	5.8	4.9	2.9			
Lock Rotor Amps:	58.8	34.8	29.4	17.4			
Horsepower:	½ HP	1/3 HP	½ HP	1/4 HP			
Pilot Duty:	125VA	125VA	125VA	125VA	125VA	125VA	

Environmental	
Operating Ambient Temperature	-4°F to +122°F (-20°C to +50°C)
Storage Temperature	-40°F to +176°F (-40°C to +80°C)
Hosedown	Listed Type 4X, meets and passed UL Standard 50, section 35 hosedown test.

Regulatory Safety Approvals	
ETL Listed	File Number 3028665
Standard Conformance	UL Standard 508 for Industrial Control Panels, Canadian CSA Standard C22.2 No14-95. UL Standard 50 for Type 4X Enclosure. Each unit HiPot tested to 1,700 Volts AC.

Ordering Information

TC-2000 Model	Description
TC-2000-120/240	120VAC or 208/240VAC Controller Power. Single Temperature Probe.
TC-2000-120/240-2	120VAC or 208/240VAC Controller Power. Dual Temperature Probes.
TC-2000-24	24VAC Controller Power. Single Temperature Probe.
TC-2000-24-2	24VAC Controller Power. Dual Temperature Probes.