

Variable Temperature Accessory Installation

MERCURY-Series NMR Spectrometer Systems

Pub. No. 01-999108-00, Rev. D1002



VARIAN

Variable Temperature Accessory

Installation

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Overview

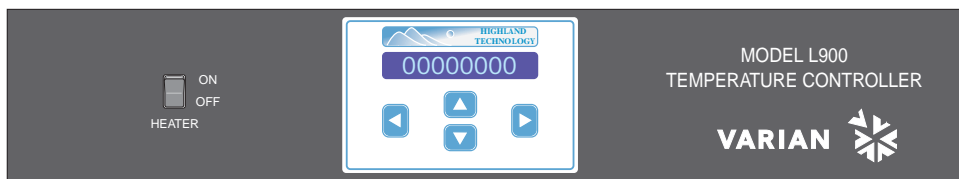
The Variable Temperature (VT) accessory for *MERCURYplus* and *MERCURY VxWorks*-Powered systems (Part No. 00-966380-05) or *MERCURY* systems (Part No. 00-966380-04) allows precise control of sample temperatures between -150°C and 250°C , as requested by the user.

The temperature is controlled by flowing gas, usually nitrogen, around the sample in the probe. For temperatures above ambient, gas at room temperature is introduced at the gas inlet on the probe and heated to the requested temperature by a heater element. For temperatures below ambient, gas at room temperature is cooled below the requested temperature by passing the gas through a heat exchanger immersed in a cryogenic substance, typically liquid nitrogen. The cooled gas then flows to the probe through a vacuum-jacketed transfer tube and a heater element in the probe warms it to the requested temperature.

VT Controller

The VT controller is designed to control the sample temperature within the probe. The controller, shown in [Figure 1](#), contains a heater enable switch and a control panel with an 8-character display and status LEDs on the front panel. The rear panel contains the ac power connector and switch, a fuse holder, and connectors J101A THERMOCOUPLE, J101B HEATER & RTD, J102 RS-232, J103 I/O, and J105 REMOTE DISPLAY. Inside the fuse cover is the line voltage selector switch. (See [“Appendix C: RS-232 Terminal Access of VT Controller,”](#) on page 15, for controller operation from an RS-232 terminal.)

Front panel



Back panel

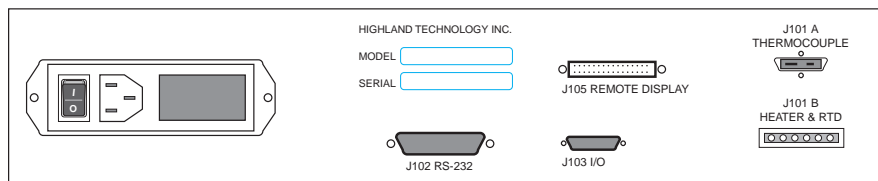


Figure 1. Variable Temperature Controller, Front and Rear View

When a user enters a temperature setting with the software parameter t_{emp} (e.g., entering $t_{emp} = -20$ for a temperature of -20°C), the current temperature is sensed by a thermocouple in the probe and displayed continuously on the front panel display of the temperature control module. The control module compares the current temperature with the value entered for the t_{emp} parameter and changes the heater current accordingly. The parameter v_{tc} (for variable temperature cutoff), set by the user, determines whether the gas is cooled first. The value of t_{emp} is shown in the SPECIAL section of the parameter display presented by entering d_g .

LN Container and Heat Exchanger

The LN (liquid nitrogen) container is constructed of polystyrene and secured to the magnet leg by an aluminum bracket. The bracket can be attached to either the front or the back of the leg, but must be at a fixed height. The bracket is secured to the magnet leg with four screws. A heat exchanger is coiled at the bottom of the LN container and connected to the low temperature inlet.

For high-temperature operation, the low-temperature line is closed. This allows the nitrogen gas to flow through the transfer tube where it is heated to the desired temperature by the probe heater element. For low-temperature operation, the high-temperature line is closed. The nitrogen gas is then routed through the heat exchanger coils and cooled by the liquid nitrogen in the LN container. The cooled gas then flows to the probe through the transfer tube, and the heater element warms it to the requested temperature.

VT Probe

The VT probe, illustrated in [Figure 2](#), consists of a probe dewar containing a heater element, a main temperature-sensing copper/constantan thermocouple, and a safety sensor, which is a platinum resistance thermocouple. The safety sensor is located directly on the heater and turns off the heater current before the element overheats.

The temperature is controlled by gas (usually nitrogen) flowing into the bottom of the dewar through the VT transfer tube into the probe. The gas is then heated to the desired value, by a heating element in the probe, and allowed to flow around the sample tube.

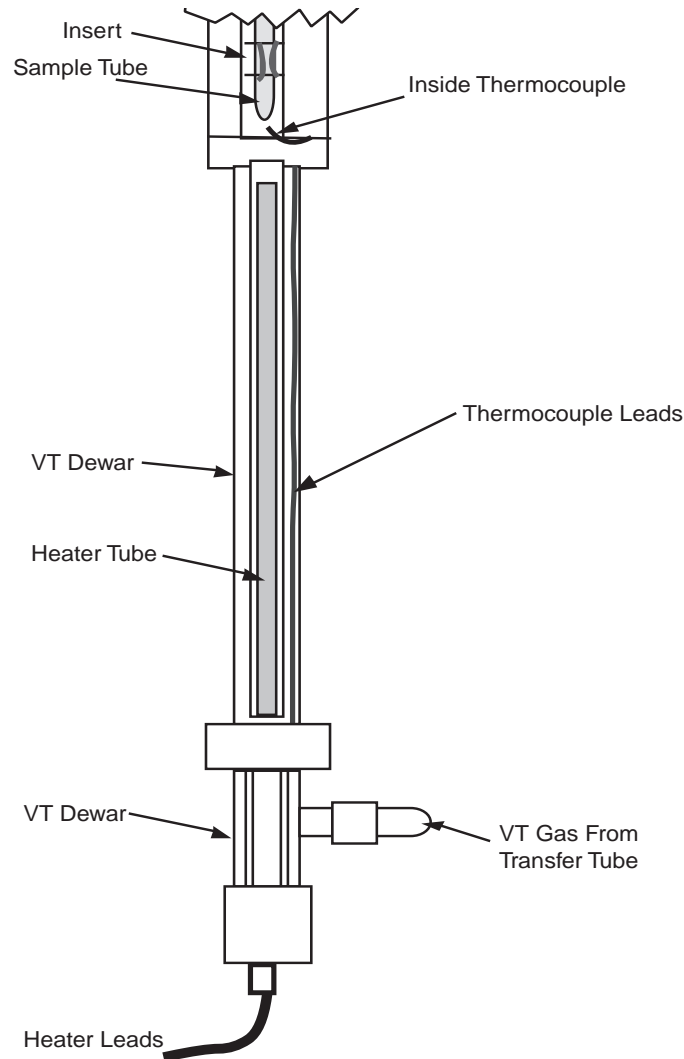


Figure 2. Variable Temperature Probe

Safety Precautions

CAUTION: Only qualified maintenance personnel shall remove equipment covers or make internal adjustments. The system contains

delicate components that can be easily damaged. Before working inside a cabinet, turn off the main system power switch located on the back of the console. Take electrostatic discharge (ESD) precautions to avoid damage to sensitive electronic components.

Requirements

MERCURY-Series NMR spectrometer system.

Parts List

The accessory consists of the following major components:

00-949041-01	Kit, Variable Temperature Subassembly. Includes: 00-953895-02 Plate, VT Cont Mtg 00-908582-00 Liquid Nitrogen Container 00-916807-00 Nitrogen Container Cap 00-916813-01 Dewar Support Collar 00-916877-00 Heat Exchanger
00-968120-79	Calibration, High Temperature, Ethylene
00-968120-80	Calibration, Low Temperature, Methanol
01-904904-00/01	Assembly, Standard VT Console, <i>MERCURY</i> . Includes: 01-903417-01 VT Module Adapter (01-904904-01 only) 01-904755-00 VT Controller Module
01-999108-00	Manual, Variable Temperature Accessory Installation

Installation Procedure

Installing the VT Controller

1. Enter **config** in the VNMR input window to bring up the CONFIG display. Set **VT Controller** to **Present** (`vttype=2`) and click **Exit and Save**.
2. Turn the main system power off. The power switch is on the back of the console as shown in see [Figure 3](#).
3. Remove the front door of the console. Open the door, lift it up, and lower it away from the console.
4. Remove the top blank panel (see [Figure 4](#)) from the front of the console; save the four screws.
5. Check that the voltage selector on the VT controller is set properly for 110 Vac. Connect the ac power cord between the connector on the back of the VT controller and the outlet strip inside the cabinet, toward the front. Turn on the VT controller.
6. Slide the VT controller into the open slot and secure with four screws.
7. Replace the front door on the console. Insert the top first.

Connecting the VT Controller System

Refer to the interconnect diagram in [Figure 5](#) during the following steps.

1. Remove the side panels from the console. Leave these panels off until the operation check is finished.
2. Connect the temperature sensor and VT heater control cable as follows:
 - a. Connect one end of the cable to J101B on the rear of the VT controller.
 - b. Route this cable through the opening on the right of the board placement panel, which is on the back of the console (see [Figure 3](#)).
 - c. Connect the other end to J6004 on the bottom of the probe.
3. Connect the VT cable between the J102 on the back of the VT controller and the appropriate connector on the Acquisition CPU:

MERCURYplus or *MERCURY-VX* – Connect the D25-to-RJ45 type VT cable (01-903417-xx) as follows:

- a. Thread the VT cable through the board placement panel.
- b. Connect one end of the cable to port 3 on the Acquisition CPU board.
- c. Connect the other end of the cable to J102 on the back of the VT controller.

MERCURY – Connect the null modem and RS-232 cable as follows:

- a. Connect a null modem to J102 on the rear of the VT controller.
- b. Connect the RS-232 cable to the null modem.
- c. Route this cable through the left opening in the board placement panel on the back of the console (see [Figure 3](#)).
- d. Connect the other end to the serial port on the Acquisition CPU board (see [Figure 3](#)).

For *MERCURY* only, this port is also used for diagnostics (this switch has no effect on *MERCURY-VX*). When the VT is connected to this port, the bootup switch (BT-UP/SEL) on the front of the console must be set to 0 for no diagnostics, as described in the next step.

- e. Set the BT-UP/SEL switch on the front of the console to 0 (see [Figure 4](#)).
4. Connect cable (00-966716-00) to J103 on the rear of the VT controller (see [Figure 1](#)). Attach the other end of this cable to P/J2017 on the rf backplane (see [Figure 5](#)).
5. Mount the Relay I/O board (00-958516-00) on the valve plate if not already present.
6. Connect cable (00-966705-00) to P/J5712 on either the Spinner Sense Tachometer board or the Autospin board (whichever is present). Connect the other end of this cable to P/J3 on the Relay I/O board, located on the valve plate.
7. Connect cable 00-966703-00 to P/J5703 on either the Spinner Sense Tachometer board or the Autospin board, whichever is present. Connect the other end of this cable to P/J1 on the Relay I/O board, located on the valve plate.
8. Install the VT pneumatic valve on the valve plate and connect it to the Relay I/O board.

Installing the LN Container

1. Install the LN container bracket. Mount the bracket on the front or rear of the right-hand magnet leg, as shown in [Figure 6](#). Make sure that the container assembly is not subject to damage from passing traffic.

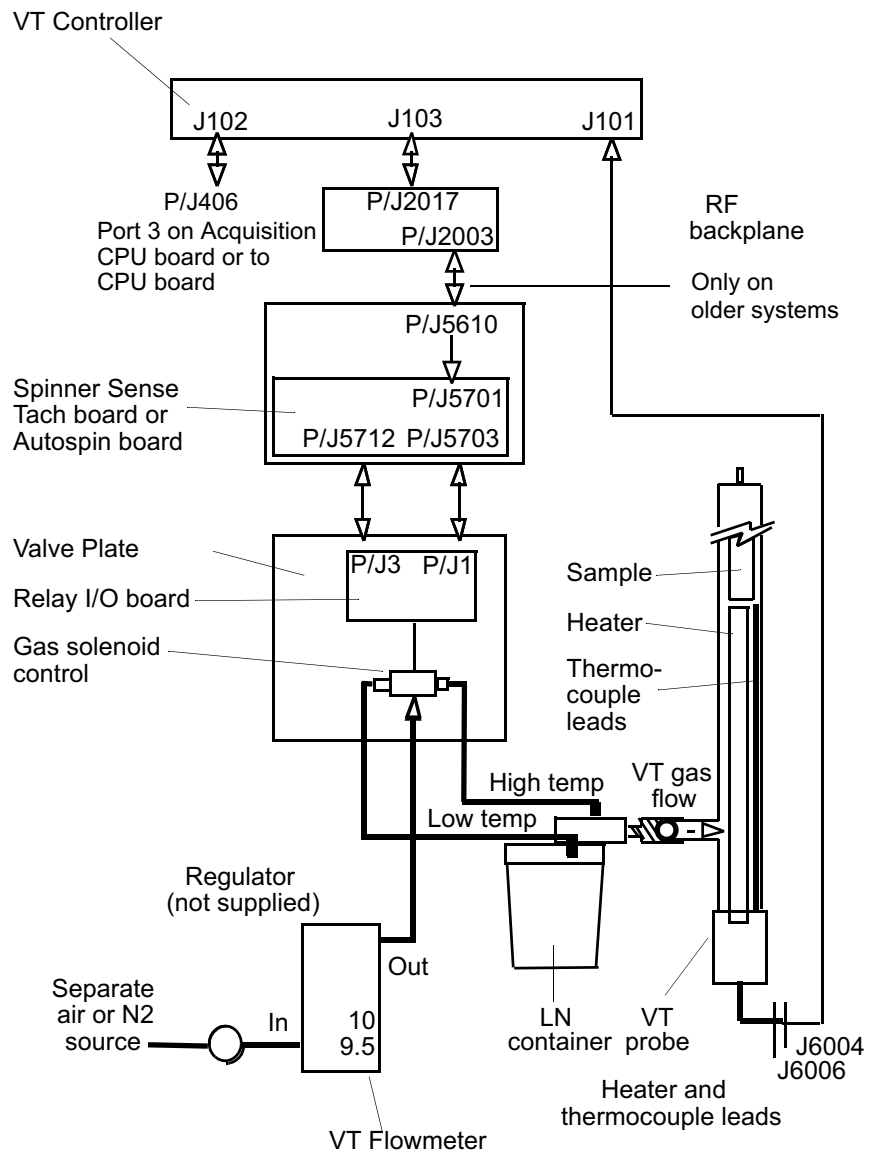


Figure 5. Variable Temperature Controller System Interconnect

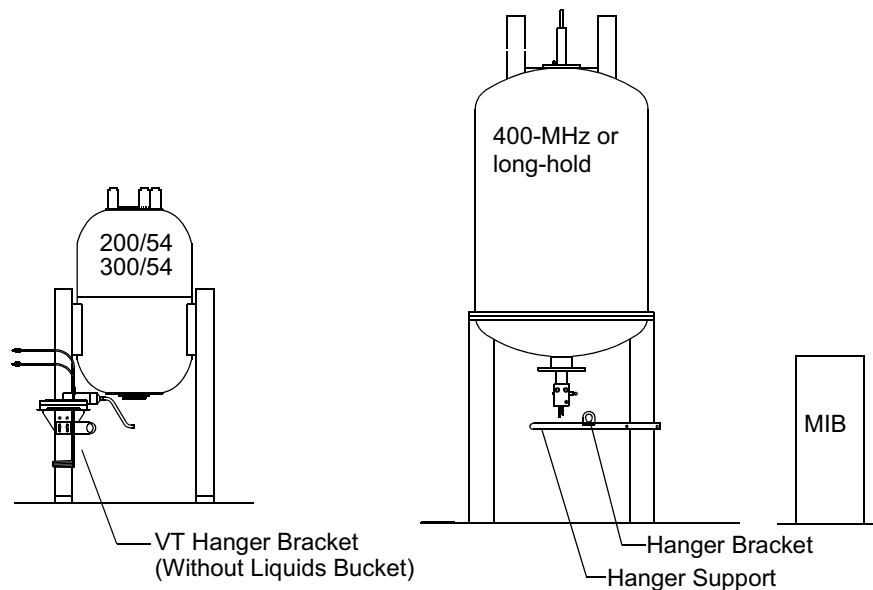


Figure 6. Installing the LN Container Bracket

2. Place the tapered, black cuff (small end first) on the longest, straight end of the transfer tube. Roll the large end of the cuff back over itself, and then place the tubular gray open cell foam seal over the end of the transfer tube. Insert the transfer tube and foam seal into the cover until the curved part of the tube is within 1.6 cm (0.5 in.) of the cover. Roll the large end of the cuff over the cover and attach a tie wrap firmly around the joint to prevent the cuff from blowing off when the nitrogen gas is flowing into the probe.
3. Check that the vacuum transfer tube can be lined up with the glass dewar in the probe without pressure on the glass. If necessary, slide the transfer tube into or out of the cover so that its other end comes close to the probe dewar. Trim the black foam to 7.5 cm (3 in.), then slip the foam cuff onto the transfer tube. Connect the transfer tube and gas inlet on the probe with the short piece of black tubing. Slide the foam over the rubber tube.
4. Connect the nitrogen gas Tygon tubing to the cover of the LN container. Connect the tube marked HIGH to the plastic hose barb on top of the cover; connect the tube marked LOW to the union provided.
5. Connect the Tygon tube labeled N2 SUPPLY to the flowmeter and then to the nitrogen gas source. (Note that the bearing/spin air must also be nitrogen gas for low temperature experiments.)

Test Procedure

Operational Check

Use dry nitrogen gas if the requested temperature is over 100°C or below 0°C. Otherwise, air can be used as the VT gas. If the requested temperature is below –40°C, dry nitrogen

gas is recommended for cooling the bearing, spinner, and decoupler. This prevents moisture condensation in the probe and spinner housing.

CAUTION: The use of air as the VT gas for temperatures above 100°C is not recommended. Such use will destructively oxidize the heater element and the thermocouple.

1. Turn on the main power switch. The system will automatically boot up.
If the VT controller does not come on, make sure the appropriate fuse, as noted on the rear panel, is installed in the fuse panel. Spare fuses are included with the Highland Technology manual for the unit.
Check that the display shows the temperature; if not, use the buttons on the front panel to display the temperature.
2. If not already done, as `vnmr1`, enter `config` and make sure **VT Controller** is set to **Present**. Click on the **Exit and Save** button.
3. Enter `dg` to display software parameters. Enter `temp='n'` to put the VT controller in the “not used” mode. Enter `vtc=20 su` to set the VT cutoff temperature to 20°C.

CAUTION: The liquid nitrogen container is constructed of polystyrene, which is dissolved by acetone. If a dry ice/acetone mixture is used as a cooling agent, a glass container (not supplied) must be used.

4. On the right-hand magnet leg, set the VT flow rate for a flowmeter reading between 9.5 LPM and 10 LPM, and check that the temperature indicator reading is approximately room temperature.
5. Enter `temp=-5 su` to request a temperature of -15°C. A click should sound in the right-hand magnet leg (if no click is heard, check the setup parameters). This click indicates that the VT controller is in the low temperature mode. The low temperature mode is selected automatically if `temp` is equal to or lower than the `vtc` temperature setting. Both are operator-selected.
6. VT gas is now flowing through the heat exchanger. Check connections by observing the flow rate, and by momentarily pinching the two hoses going to the bucket cover. Then check that gas is flowing into the metal tube and not into the plastic hose barb on top.
7. Enter `temp=25 su` to request a temperature of 25°C. The gas should flow into the nylon hose barb on the top of the bucket. This is the high temperature operating mode. The VT gas bypasses the heat exchanger coils in the liquid nitrogen bucket.

After the operational check is finished, replace the console side panels.

Adjusting Sample Temperature

1. Insert the high-temperature sample.
2. If the probe specification indicates the probe can reach a temperature of 125°C, enter `temp=125 su` to set the temperature to 125°C. Otherwise, set `temp` to the highest temperature the probe can reach according to the specification.
3. When the temperature settles, the temperature readout on the VT controller front panel will match the temperature you entered.

“Appendix B: Chemical Shift Frequencies,” on page 10, lists the ¹H chemical shift for ethylene glycol and methanol at 200 MHz and 300 MHz.

Operation

Refer to the system operation manuals for variable temperature operation.

Schematic Drawings

In general, refer to the system interconnect drawings that shipped with the console. Attached to this manual is the following drawing that applies to the Part No. 00-966380-04 version of the Variable Temperature Accessory:

87-178722-00 Schematic, Relay Interface Board

Appendix A: Setting MAX TEMP Limit

Highland L900 VT controllers with firmware revision 26901H and newer include a MAX TEMP parameter. The L900 shuts down if either the actual temperature, the setpoint temperature, or the slew setpoint exceed the MAX TEMP limit. The MAX TEMP parameter is factory set to 30.0 C.

The MAX TEMP value can only be set from the L900 front panel; it cannot be changed using the RS-232 interface.

- To set MAX TEMP: Press and hold the left-arrow key, and push the up/down keys to change the setting.

MAX TEMP is set in 5-degree steps, in the range of 0 to 200C. The revision H firmware limits the L900 to an operating range of -200C to 200C.

MAX TEMP is nonvolatile and is preserved through power-down cycles. Users can use the MAX TEMP parameter as a safety limit to protect delicate samples from accidental overheating.

Appendix B: Chemical Shift Frequencies

Sections in this appendix:

- [Ethylene Glycol Chemical Shift at 200 MHz, page 11.](#)
- [Methanol Chemical Shift at 200 MHz, page 12.](#)
- [Ethylene Glycol Chemical Shift at 300 MHz, page 13.](#)
- [Methanol Chemical Shift at 300 MHz, page 14](#)

Ethylene Glycol Chemical Shift at 200 MHz

Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)
20	340	67	248	114	154	161	63
21	338	68	246	115	152	162	61
22	336	69	244	116	150	163	59
23	334	70	242	117	148	164	57
24	332	71	240	118	146	165	55
25	330	72	238	119	144	166	53
26	328	73	236	120	142	167	51
27	326	74	234	121	140	168	49
28	324	75	232	122	138	169	47
29	322	76	230	123	136	170	45
30	320	77	228	124	134	171	43
31	318	78	226	125	132	172	41
32	316	79	224	126	130	173	39
33	314	80	222	127	128	174	37
34	312	81	220	128	126	175	35
35	310	82	218	129	124	176	33
36	308	83	216	130	122	177	31
37	306	84	214	131	121	178	29
38	304	85	212	132	120	179	27
39	302	86	210	133	118	180	25
40	300	87	208	134	116	181	23
41	298	88	206	135	114	182	21
42	296	89	204	136	112	183	19
43	294	90	202	137	110	184	17
44	292	91	200	138	108	185	15
45	290	92	198	139	106	186	14
46	288	93	196	140	104	187	12
47	286	94	194	141	103	188	8
48	284	95	192	142	101	189	6
49	282	96	190	143	99	190	5
50	280	97	188	144	97	191	3
51	278	98	186	145	95	192	0
52	276	99	184	146	93	193	-1
53	274	100	182	147	91	194	-3
54	272	101	180	148	89	195	-5
55	270	102	178	149	87	196	* -7
56	268	103	176	150	85	197	-8
57	266	104	174	151	83	198	-10
58	264	105	172	152	81	199	-12
59	262	106	170	153	79	200	-15
60	261	107	168	154	77		
61	260	108	166	155	75		
62	258	109	164	156	73		
63	256	110	162	157	71		
64	254	111	160	158	69		
65	252	112	158	159	67		* Boiling point
66	250	113	156	160	65		

Methanol Chemical Shift at 200 MHz

Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)
50	262	3	354	-44	431	-91	498
49	264	2	355	-45	433	-92	499
48	267	1	356	-46	434	-93	500
47	270	0	358	-47	435	-94	502
46	271	-1	360	-48	437	-95	503
45	273	-2	362	-49	439	-96	505
44	275	-3	364	-50	440	-97	506
43	278	-4	366	-51	442	-98	507
42	280	-5	367	-52	443	-99	508
41	282	-6	369	-53	445	-100	510
40	284	-7	371	-54	446	-101	511
39	285	-8	373	-55	448	-102	513
38	286	-9	375	-56	449	-103	514
37	288	-10	376	-57	451	-104	515
36	290	-11	377	-58	452	-105	516
35	293	-12	378	-59	454	-106	518
34	294	-13	380	-60	455	-107	520
33	297	-14	382	-61	456	-108	521
32	300	-15	384	-62	458	-109	522
31	301	-16	386	-63	460	-110	523
30	303	-17	388	-64	461	-111	524
29	304	-18	389	-65	463	-112	525
28	307	-19	391	-66	464	-113	527
27	310	-20	393	-67	465	-114	528
26	311	-21	394	-68	467	-115	529
25	312	-22	396	-69	468	-116	531
24	314	-23	398	-70	469	-117	532
23	316	-24	400	-71	470	-118	533
22	318	-25	401	-72	472	-119	534
21	320	-26	403	-73	473	-120	535
20	322	-27	404	-74	475	-121	537
19	323	-28	406	-75	476	-122	538
18	326	-29	408	-76	478	-123	539
17	328	-30	409	-77	479	-124	540
16	330	-31	411	-78	480	-125	541
15	332	-32	412	-79	481	-126	543
14	334	-33	413	-80	483	-127	544
13	336	-34	415	-81	485	-128	545
12	338	-35	417	-82	486	-129	546
11	340	-36	419	-83	487	-130	547
10	341	-37	420	-84	488		
9	342	-38	422	-85	489		
8	344	-39	423	-86	491		
7	346	-40	425	-87	493		
6	348	-41	426	-88	494		
5	350	-42	428	-89	495		
4	352	-43	429	-90	496		

Ethylene Glycol Chemical Shift at 300 MHz

Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)	Temp. (°C)	Shift (Hz)
20	511	70	363	120	215	170	68
21	508	71	360	121	213	171	65
22	505	72	357	122	210	172	62
23	502	73	354	123	207	173	59
24	499	74	351	124	204	174	56
25	496	75	348	125	201	175	53
26	493	76	345	126	198	176	50
27	490	77	342	127	195	177	47
28	487	78	339	128	192	178	44
29	484	79	336	129	189	179	41
30	481	80	334	130	186	180	38
31	478	81	331	131	183	181	35
32	475	82	328	132	180	182	82
33	472	83	325	133	177	183	30
34	469	84	322	134	174	184	27
35	466	85	319	135	171	185	24
36	463	86	316	136	168	186	21
37	460	87	313	137	165	187	18
38	457	88	310	138	162	188	15
39	455	89	307	139	159	189	12
40	452	90	304	140	156	190	9
41	449	91	301	141	153	191	6
42	446	92	298	142	151	192	3
43	443	93	295	143	148	193	0
44	440	94	292	144	145	194	-3
45	437	95	289	145	142	195	-6
46	434	96	286	146	139	196	-9
47	431	97	283	147	136	197	-12
48	428	98	280	148	133	198	-15
49	425	99	277	149	130	199	-18
50	422	100	274	150	127	200	-21
51	419	101	272	151	124	201	-24
52	416	102	269	152	121	202	-27
53	413	103	266	153	118	203	-30
54	410	104	263	154	115	204	-32
55	407	105	260	155	112	205	-35
56	404	106	257	156	109	206	-38
57	401	107	254	157	106	207	-41
58	398	108	251	158	103	208	-44
59	396	109	248	159	100	209	-47
60	393	110	245	160	97	210	-50
61	390	111	242	161	94	211	-53
62	387	112	239	162	91	212	-56
63	384	113	236	163	89	213	-59
64	381	114	233	164	86	214	-62
65	378	115	230	165	83	215	-65
66	375	116	227	166	80	216	-68
67	372	117	224	167	77	217	-71
68	369	118	221	168	71	218	-74
69	366	119	218	169	71	219	-77

Methanol Chemical Shift at 300 MHz

<i>Temp.</i> (°C)	<i>Shift</i> (Hz)	<i>Temp.</i> (°C)	<i>Shift</i> (Hz)	<i>Temp.</i> (°C)	<i>Shift</i> (Hz)
50	395	0	539	-50	660
49	398	-1	541	-51	662
48	401	-2	544	-52	664
47	404	-3	547	-53	666
46	407	-4	549	-54	668
45	411	-5	552	-55	671
44	414	-6	554	-56	673
43	417	-7	557	-57	675
42	420	-8	559	-58	677
41	423	-9	562	-59	680
40	426	-10	564	-60	682
39	429	-11	567	-61	684
38	432	-12	569	-62	686
37	435	-13	572	-63	688
36	438	-14	574	-64	690
35	441	-15	577	-65	693
34	444	-16	579	-66	695
33	447	-17	582	-67	697
32	450	-18	584	-68	699
31	453	-19	587	-69	701
30	456	-20	589	-70	703
29	459	-21	592	-71	706
28	462	-22	594	-72	708
27	465	-23	597	-73	710
26	468	-24	599	-74	712
25	471	-25	601	-75	714
24	473	-26	604	-76	716
23	476	-27	606	-77	718
22	479	-28	609	-78	720
21	482	-29	611	-79	722
20	485	-30	613	-80	725
19	488	-31	616	-81	727
18	490	-32	618	-82	729
17	493	-33	620	-83	731
16	496	-34	623	-84	733
15	499	-35	625	-85	735
14	501	-36	627	-86	737
13	504	-37	630	-87	739
12	507	-38	632	-88	741
11	510	-39	634	-89	743
10	512	-40	637	-90	745
9	515	-41	639	-91	747
8	518	-42	641	-92	749
7	520	-43	644	-93	751
6	523	-44	646	-94	753
5	526	-45	648	-95	755
4	528	-46	651	-96	758
3	531	-47	653	-97	760
2	534	-48	655	-98	762
1	536	-49	657	-99	764

Appendix C: RS-232 Terminal Access of VT Controller

Sections in this appendix:

- [Data Protocols, Status Codes, and Internal Variables, this page](#)
- [Manual Operation Through an RS-232 Terminal, page 15](#)

An RS-232 terminal can provide access to the operation of the Highland VT controller. This appendix summarizes the operation. No null modem is needed when operating from a terminal.

Data Protocols, Status Codes, and Internal Variables

Data protocols for RS-232 terminal:

Baud rate	9600		
Tx start bits	1	Rx start bits	1
Tx data bits	8	Rx data bits	8
Tx stop bits	2	Rx stop bits	≥1

VT controller status codes displayed on terminal:

S+0	Controller in standby or manual control
S+1	Temperature stable at set point
S+2	Temperature changing
S+3	Safety sensor limiting output
S-1	Gas not flowing or output stage fault
S-2	Main sensor at lower limit
S-3	Main sensor on upper limit or thermocouple open circuit
S-4	Short circuit in safety sensor
S-5	Open circuit in safety sensor

Internal variables displayed on VT controller front panel:

F0	Measured temperature
F1	Set temperature
F2	Difference between set and measured temperatures x 20
F3	Percentage of full output
F4	Safety sensor resistance
F5	RT sensor value in °C
F6, F7, F8	Input frequencies x 1/4 for channels 1, 2, and 3, respectively. These frequencies are the outputs of the respective voltage frequency converters.
F9, F10, F11	Parameter values P, I, and D, respectively. Respective default values are 4, 4, 0.

Manual Operation Through an RS-232 Terminal

The functions of the VT controller can be accessed from the RS-232 terminal, thereby providing complete control of the VT unit from the RS-232 terminal.

The following commands control the sample temperature:

Tnnnnn	Set temperature—last digit is in tenths of a degree; for example T1230 is 123.0°, T12 is 1.2° (not 12.0°).
Gn	Gas solenoid control: G0 is gas off and G1 is gas on.
A	Commence automatic control
M	Return to manual mode
B	Return to standby mode
N	Return to normal mode

Internal variables can be displayed on the terminal, without affecting the front panel readout, by using the following commands:

R	Measured temperature	Same as F0
E	Error between the set and measured temperatures	Same as F2
H	Heater output	Same as F3
S	Current status	
V	Software version number	

Variable Temperature Accessory

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Revision history:

A0399 – Initial release

B0401 – Update for *MERCURYplus*

C0902 – Update for Magnet Interface box (MIB)

D1002 – Max Temp Limit instructions for L900 EPROM 26901H upgrade

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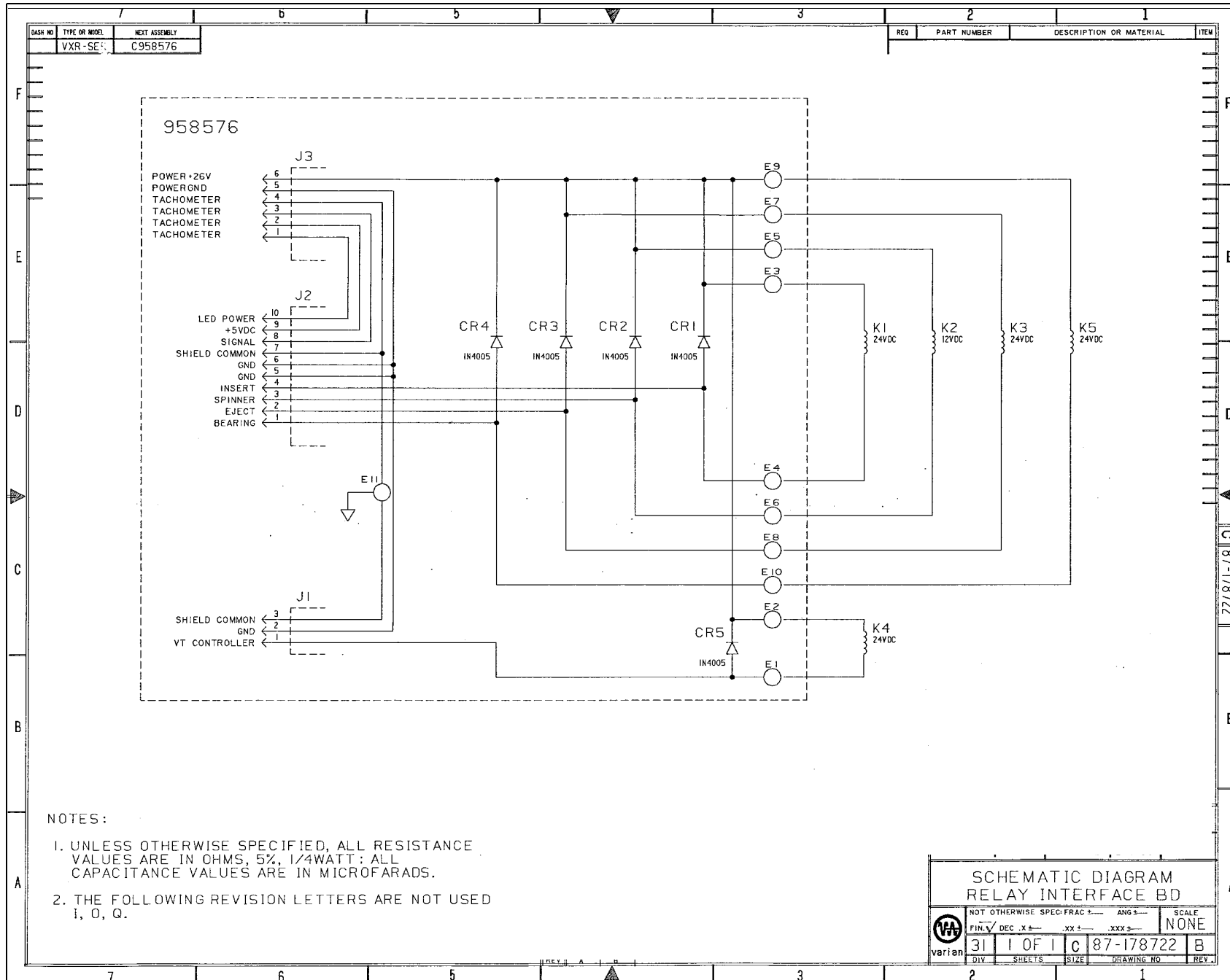
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R. Des	component desc	qty
	8717872200 REF SCHEMATIC	.001 EA
2	0095857701 RELAY IN'FC BD DTL	1.000 EA
CR1	6639695000 DIODE, RECTIFIER 1AM	1.000 EA
CR2		1.000 EA
CR3		1.000 EA
CR4		1.000 EA
CR5		1.000 EA
J1	5140702300 CONN., PC CARD, 3 PIN	1.000 EA
J2	5120925900 HEADER,PC/FL.CAB,10P	1.000 EA
J3	5140815400 PIN HDR. ASSY.	1.000 EA

