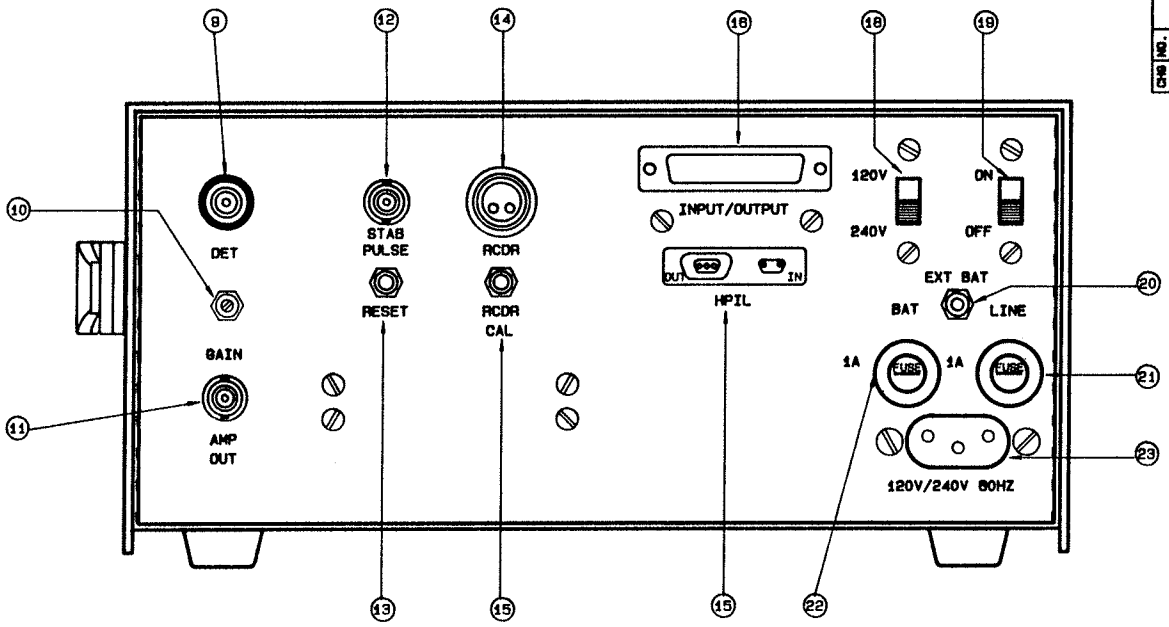
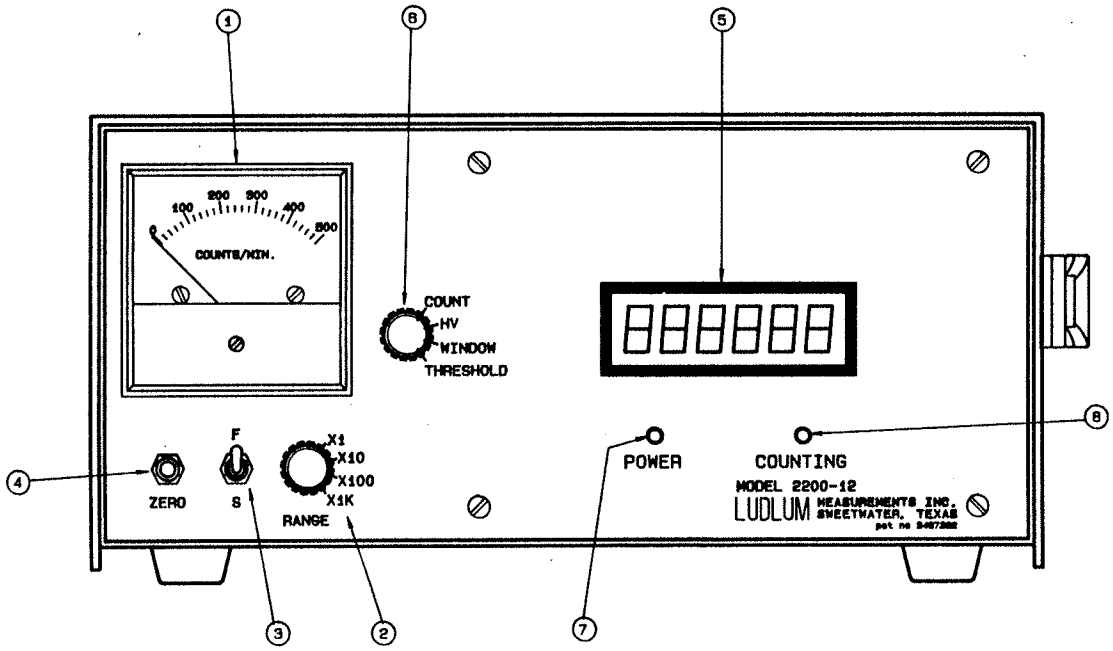


MODEL 2200-12 BACK PANEL



MODEL 2200-12 FRONT PANEL

LUDLUM MODEL 2200-12 RATEMETER

TABLE OF CONTENTS

FEBRUARY 1984

LUDLUM MODEL 2200-12 RATEMETER

1. GENERAL

The Model 2200-12 is a self-contained counting instrument compatible with the Hewlett Packard Interface Loop (HPIL). The unit is complete with a voltage-sensitive preamplifier, a linear amplifier, a timer, a detector high-voltage power supply, a single channel analyzer and HPIL interface circuitry. All operating parameters are set via the HPIL loop.

2. SPECIFICATIONS

HIGH VOLTAGE: 200 to 2500 volts

SENSITIVITY: voltage sensitive; adjustable from 1.5 millivolts to 200 millivolts; factory setting at 10 millivolts

INPUT IMPEDANCE: 22,000 ohms

READOUT: 6-digit, 1/2-inch tall, liquid crystal display, count overflow at 16,777,216 counts

METER: 2 1/2-inch scale

SCALE: 0-500 counts per minute with multipliers of X1, X10, X100, X1K

METER RESPONSE: fast - 3 seconds, slow - 15 seconds to 67% of full scale deflection

AMP OUT: positive polarity amplifier output with 1K ohm output impedance

RECORDER: meter drive signal adjustable up to approximately 1 volt full scale

EXTERNAL INPUTS: 8 each CMOS inputs active low with 22K pullup (to +5 volts) resistors; input Lo voltage of 1.5 volts and input Hi voltage of 3.5 volts

OUTPUTS: 2 each relay contacts rated at 250 milliamps at 28 VDC and 6 each open collector transistors rated at 40 milliamps at 15 volts

AC POWER: 120/240 volts AC, 50/60 Hz at 2.5 watts

EXTERNAL BATTERY: 6 VDC to 14 VDC at 150 milliamps

INTERNAL BATTERY: 6 volt, 1 amp/hour with a built-in recharger; full charge will provide 6-8 hours of operation

DETECTOR CONNECTOR: Series "C"

AMP CONNECTOR: Series "BNC"

STAB CONNECTOR: Series "BNC"

RCDR CONNECTOR: Amphenol 80CP2F

IN/OUT CONNECTOR: 25-pin Series "D"

SIZE: 10.25 inches wide x 9.25 inches deep x 5 inches tall

WEIGHT: 8 pounds 4 ounces

3. DESCRIPTION OF CONTROLS AND FUNCTIONS

3.1 Front Panel (numbers correspond to front and back panel drawings)

1. Meter displays the count rate.
2. RANGE is a 4-position switch marked X1, X10, X100, X1K. Moving the range selector switch to one of the range multiplier positions (X1, X10, X100, X1K) provides the operator with an overall range of 0 to 500,000 counts per minute. Multiply the meter scale reading by the multiplier for determining the actual scale reading.
3. Response Switch provides meter response selection. Selecting the "F" position of the toggle switch provides 67% of full scale meter deflection in 3 seconds. In the "S" position, 67% of full scale meter deflection takes 15 seconds.
4. ZERO, when pressed, zeros the meter drive.
5. Display is a 6-digit liquid crystal display.
6. Display Mode is a 4-position switch marked COUNT, HV, WINDOW, THRESHOLD. This switch is used to select the function to be presented on the display.
7. POWER is a green LED that illuminates when power is on.
8. COUNTING is a red LED that is illuminated when the counter is active.
9. DET is a Series "C" connector for the detector connection.
10. GAIN is a potentiometer control for adjusting the

sensitivity. The sensitivity is adjustable from 1.5 millivolts to 200 millivolts.

11. AMP OUT is a Series "BNC" connector providing an output pulse from the amplifier.
12. STAB PULSE is a Series "BNC" connector providing an LED drive for LED stabilized detectors.
13. RESET, when pressed, resets the Model 2200-12 to power-on status.
14. RCDR is a connector for meter drive output.
15. RCDR CAL is an adjustment for the recorder output. It is adjustable to approximately 1 volt full scale.
16. INPUT/OUTPUT is a connector providing external input and output signals.
17. HPIL Receptacle provides connection to the Hewlett Packard Interface Loop.
18. Voltage Selector Switch is used to select the power input. In the 120V position, the input range is 90V to 130V. In the 240V position, the input range is 180V to 260V.
19. ON/OFF Power Switch provides AC power or battery power to the instrument.
20. EXT BAT is an 1/8-inch phone jack used for connecting an external battery pack. The acceptable input voltage is from 6 to 14 volts DC.
21. LINE Fuse is a 1 amp line fuse.
22. BAT Fuse is a 1 amp battery fuse.
23. AC Receptacle is used to plug the AC power cord in.

4. OPERATING PROCEDURES

4.1 Connect the desired devices on the HPIL loop. The minimum devices required are one controller (such as the HP41CV) and one Model 2200-12.

4.2 Turn all the devices on. All the devices on the loop must be on for proper loop function.

4.3 Verify the operation of the loop and then proceed with use of the devices.

5. COMMANDS AND RESPONSES

COMMAND	COMMAND TYPE
HS-------set the high voltage in volts	S
WS-------set the window	S
TS-------set the threshold	S
CS-------set count time in tenths of minutes	S
HR-------read high voltage	R
WR-------read window	R
TR-------read threshold	R
CR-------read count time	R
C-------reset the scaler and start counting	C
H-------stop scaler	C
IR-------read external inputs	R
FS-------set input flag register	S
FR-------read input flag register	R
OS-------set outputs	S
OR-------read outputs	R
OC-------reset outputs	S
CT-------read remaining count time in tenths of minutes	R
SR-------read scaler contents	R
CL-------load default settings (leave HPIL as is)	C
MS-------set service request mask	S
MR-------read service request mask	R
SS-------turn stabilizer on	C
SC-------turn stabilizer off	C
VR-------read software version	R

5.1 Command Types

a. S - set commands: This type of command is a 2-step command. First, the command is issued; and, then, a data message is sent. The command will not execute until the data message is received.

b. R - read command: This type of command will prepare the requested data for transmission. To use this command, send the command. Then input the data from the Model 2200-12.

c. C - control commands: This type of command does not involve any data transfer. When one of these commands is sent, the command is immediately executed.

5.2 Command Descriptions

a. Set Commands

HS - This command will set the high voltage to the value of the following data message. The allowable range is from 0 to 2500. Only the last 4 digits received will be used. If the value sent is greater than 2500, the number will be replaced by 2500. All non-numeric values are ignored.

Examples:

Data Message Sent	Value HV Set To
0	0
1000	1000
3000	2500 (max. value is 2500)
10750	750 (only last 4 digits used)
17.50	1750 (non-numeric characters ignored)

WS - This command sets the window. The operation is the same as the HS command with the exception that the maximum value is 1001. If the value is between 0 and 1000, the window will be set to that value. If the value is 1001, the window is turned off. This will disable the single channel analyzer and allow gross counting.

Data Message Sent	Value Window Set To
0	0 window on
100	100 window on
1000	1000 window on
1001	1001 window off
2000	1001 window off (maximum value is 1000)
20161	161 window on (only last 4 digits used)

TS - This command sets the threshold setting. The operation is the same as the HS command with the exception that the maximum value is 1000.

Data Message Sent	Threshold Value
0	0
600	600
3000	1000 (maximum value is 1000)
10763	763 (only last 4 digits used)

CS - This command sets the count time in tenths of minutes. The allowable range is from 1 to 9999 (0.1 to 999.9 minutes). The last 4 digits received are used.

Data Message	Count Time in Minutes
1	0.1
9.99	99.9
9999	999.9
80763	76.3

FS - This command loads the external input service request mask. This will cause the external input flag bit of the status register to be set when the flagged external input bit is set. This bit will remain set as long as the input is set. The input number and values are listed below:

Input Bit	Value
7	128
6	64
5	32
4	16
3	8
2	4
1	2
0	1

The allowable range is from 0 to 255. To select the appropriate flag bits, add the value for each bit selected. This will be the data message transmitted after the FS command.

Example: Set the flag register for inputs 0, 2 or 5.

Selected Inputs	Bit Value
5	32
2	4
0	1
Data message	37

When this message is sent and then the inputs 5, 2 or 0, or any combination of the three selected inputs is set, the input flag bit of the status register will be set.

OS - This command will set the selected output. The allowable range is from 1 to 8.

OC - This command will clear the selected output. The allowable range is from 1 to 8.

MS - This command loads the service request mask register. When the service request bit is enabled and a condition occurs that will set the service request, the service request bit of the HPIL loop will be set. When the status register is read, the service request bit will be cleared. The bits and bit values are listed below:

Bit #	Function	Mask Bit Value
7	none	none
6	service request	64
5	counter ready	32
4	overflow	16
3	input requested	8
2	stabilizer on	none
1	external input flag	2
0	none	none

To set the service request mask, add the bit value of the selected bits. This will be the data message transmitted after the MS command. If bits 0, 2 or 7 are set in the data message, they will be ignored by the Model 2200-12.

Example: Set the service request for overflow or input requested:

Bit Selected	Bit Value
service request	64
overflow	16
input requested	8
data message	88

b. Read Commands

HR - This command loads the Model 2200-12 transmit buffer with the value of the high voltage.

WR - This command loads the Model 2200-12 transmit buffer with the value of the window.

TR - This command loads the Model 2200-12 transmit buffer with the value of the threshold.

CR - This command loads the Model 2200-12 transmit buffer with the count time in tenths of minutes.

IR - This command loads the Model 2200-12 transmit buffer with a number representing the external inputs as determined by the following table. The inputs are active Lo.

Input #	Bit Value
7	128
6	64
5	32
4	16
3	8
2	4
1	2
0	1

Example:

Bits Set	Bit Value
6	64
4	16
2	4
0	1
Input Value	85

The number stored in the transmit buffer would be 85.

FR - This command loads the input flag register contents into the Model 2200-12 transmit buffer. It uses the same bit values as the FS command.

OR - This command loads the Model 2200-12 transmit buffer with a number representing the outputs that are set as listed below:

Output	Bit Value
8	128
7	64
6	32
5	16
4	8
3	4
2	2
1	1

Example: Outputs 1, 2, 3 and 8 are set.

Output	Bit Value
8	128
3	4
2	2
1	1
Output Value	135

The value loaded into the transmit buffer would be 135.

CT - This command loads the count time left before time out in tenths of minutes into the Model 2200-12 transmit buffer.

SR - This command loads the Model 2200-12 transmit buffer with the scaler contents. The largest number before overflow is 16,777,215.

MR - This command loads the Model 2200-12 transmit buffer with the service request mask using the same bit values as the MS command.

VR - This command loads the Model 2200-12 transmit buffer with the message VER. 1.0.

All read commands load eight characters, a carriage return code, and a line feed code into the transmit buffer. Leading digits not used are set to zero.

c. Control Commands

C - This command resets the Model 2200-12 counter, clears the overflow bit, loads the count time into the count remaining register, and then enables the counter.

H - This command will stop the counter.

CL - This command loads the default settings of the Model 2200-12. They are as follows:

HV	0 volts
Threshold	100
Window	1001
Count Time	0.1 minutes

Clears all outputs.
Clears the flag register.
Clears the mask register.
Clears the overflow bit.

SS - This command will turn the stabilizer on. Do not use this command unless a stabilized probe is connected to the Model 2200-12 as the high voltage will rise to between 600 volts and 1500 volts which may cause damage if the probe is not rated for these voltages.

To use this command, the HS command is used to determine the trigger level of the stabilizer pulse. Because of this, the actual data sent will not correspond to the actual high voltage. The actual value to be used will vary from unit to unit and needs to be determined by trial and error. Once the value has been found, it should remain constant for a particular Model 2200-12 and probe.

When the stabilizer is on, live time correction is done to compensate for the stabilizer pulse effects. This will make the actual count time appear to be longer than normal.

SC - This command turns off the stabilizer and returns the high voltage control back to normal. Before using this command, it is recommended to set the high voltage to zero so that probe damage will not occur.

5.3 Status Register Description

The status register indicates the status of the Model 2200-12. This register can be interrogated as needed. The bits are described below:

Bit #	Function
7	always Lo
6	service request
5	counter ready
4	overflow
3	input requested
2	stabilizer on
1	external input flag
0	always Lo

Bit 6 - Service Request: This bit is set whenever bit 1, 3, 4 or 5 is set. The service request bit on the HPIL loop is only set when the bits make the transition from cleared to set. Once the service request has been answered, the set bits will have no effect until they are cleared and set again.

Bit 5 - Counter Ready: This bit is Hi when the counter is not busy counting. When the counter is reset and a new count is started, this bit will go Lo.

Bit 4 - Overflow: This bit is Hi when a count overflow occurs. The overflow occurs at 16,777,216 counts. This bit will remain set until the counter is reset and restarted.

Bit 3 - Input Requested: This bit is set Hi whenever the input request line is pulled Lo. When the input request line goes Hi again, this bit will go Lo.

Bit 2 - Stabilizer On: This bit is set Hi when the stabilizer is on and is set Lo when the stabilizer is off. This bit has no effect on Bit 6.

Bit 1 - External Input Flag: This bit is set Hi when one or more of the external inputs enabled by the External Input Flag register are set Lo. This will stay Hi until all enabled bits are Hi.

5.4 HPIL Responses

HPIL MESSAGE	PRINTER RESPONSE
COMMAND GROUP	
Interface Clear	Removes talker or listener status.
Device Clear	Clears outputs, clears service request mask, clears external input flags, sets HV=0, W=1001, T=0100 and count time=0.1 minutes.
Selected Device Clear	If listener, device cleared as with Device Clear command.
Go To Local	No response.
Local Lockout	No response.
Remote Enable	No response.
Not Remote Enable	No response.
Parallel Poll Enable 0-15	No response.
Parallel Poll Disable	No response.
Parallel Poll Unconfigure	No response.
Group Execute Trigger	No response.
Loop Power Down	Device goes to low power state and sets itself to turn on if a signal is received. The address is then set to 2.
Enable Asynchronous Requests	No response.

Auto Address Unconfigure	Address set to 2.
Not Ready for Data	If talker, makes previous data byte the last byte sent, then sends End of Transmission message.
End of Transmission-OK	If talker, sent at end of data transmission.
End of Transmission-Error	If talker, sent immediately for bad HPIL error check.
Auto Address 0-31	If device has earlier auto address, no response. If address is 31, no response. If message address less than 31 and device does not have earlier auto address, sets device address to message address, increments message address by one, and passes revised message.
Auto Extended Primary 0-31	No response.
Auto Extended Secondary 0-31	No response.
Auto Multiple Primary 0-31	No response.
Listen Address 0-31	If address matches, device removed from talker status and becomes a listener. If address is 31, device removed from listener status.

Unlisten	Device removed from listener status.
Device Dependent Listener 0-31	See Table 1.
Talk Address 0-31	If address matches, device removed from listener status and becomes a talker. If address does not match, device removed from talker status.
Untalk	Device removed from talker status.
Device Dependent Talker 0-31	See Table 2.
Secondary Address 0-30	No response.
Null	No response.

READY GROUP

Take Control	No response.
Ready for Command	Executes a pending Loop Power Down command.
Send Data	If talker, sends pending data*.
Send Status	If talker, sends one byte of status (refer to Table 3).*
Send Device ID	If talker, sends message LMI2200-12*.
Send Accessory ID	If talker, sends one byte with the value 7E*.

*Indicates that the received message is not passed to the next device in the loop.

IDENTIFY GROUP

Identify (no service request)	No response.
Identify (service request)	If service needed, sets service request bit.

DATA GROUP

Data Byte (no service request) Data Byte (service request)	If talker, performs HPIL error check and sends next data byte*. If listener, accepts data byte and passes to next device.
End Byte (no service request) End Byte (service request)	If listener, accepts data byte and passes to next device.

6. TABLES

Table 1 DDL Commands

DDL #	Command Executed
0	no response
1	HS
2	WS
3	TS
4	CS
5	C
6	H
7	FS
8	OS
9	MS
10-11	no response
12	SS
13	SC
14	no response
15	OC
16-31	no response

*Indicates that the received message is not passed to the next device in the loop.

Table 2 DDT Commands

DDT #	Command Executed
0	no response
1	HR
2	WR
3	TR
4	CR
5-6	no response
7	FR
8	OR
9	MR
10	CT
11	SR
12-13	no response
14	IR
15	no response
16	VR
17-31	no response

Table 3 Status Register

bit #	Function
7	no function
6	service request
5	counter ready
4	overflow
3	input requested
2	stabilizer on
1	external input flag
0	no function

7. SAMPLE PROGRAMS

The following programs use the HP41CV with the HPIL module #HP82160A as the system controller. The HP41 Calculator should be set to no decimal places with the FIX command and should be in the AUDIO mode.

	NAME	FUNCTION
7.1	HVS	Set and read high voltage.
7.2	WIN	Set and read window.
7.3	THR	Set and read threshold.
7.4	CNTS	Set and read count time.
7.5	COUNT	Start counter and input count data.
7.6	OUTS	Set and read outputs.
7.7	OUTC	Clear and read outputs.
7.8	CNT	Start counter.
7.9	CNTM	Read remaining count time.
7.10	HOLD	Stop counter.
7.11	INPUT	Read external inputs.
7.12	CLEAR	Clear Model 2200-12.
7.13	FLAG	Set and read input flags.
7.14	MASK	Set and read service request mask.
7.15	STBON	Turn stabilizer on.
7.16	STBOFF	Turn stabilizer off.
7.17	VER	Read software version number.

7.1 Set and Read High Voltage - To run this program, place the voltage wanted into the "X" register. Then execute the program.

```
LBL "HVS"       Program Name
"HS"            Instruction to set high voltage.
OUTA            Outputs alpha register to HPIL
                loop.
CLA             Clears alpha register.
ARCL X          Puts contents of "X" register in
                the alpha register.
OUTA            Outputs alpha register to HPIL
                loop.
"HR"            Instruction to read high voltage.
OUTA            Outputs alpha register to HPIL
                loop.
IND             Inputs data from HPIL loop and
                places in the "X" register.
```

7.2 Set and Read Window Setting - The operation of this routine is identical to the HVS routine.

```
LBL "WIN"
"WS"
OUTA
CLA
ARCL X
OUTA
"WR"
OUTA
IND
```

7.3 Set and Read Threshold Setting - The operation of this routine is identical to the HVS routine.

```
LBL "THR"
"TS"
OUTA
CLA
ARCL X
OUTA
"TR"
OUTA
IND
```

7.4 Set and Read Count Time - The operation of this routine is identical to the HVS routine.

```
LBL "CNTS"
"CS"
OUTA
CLA
ARCL X
OUTA
"CR"
OUTA
IND
```

7.5 Start counter and at end of count time input scaler contents. It is assumed that the high voltage, window, threshold, and count time have already been set.

```
LBL "COUNT"          Program Name
"C"                  Count instruction
OUTA                 Output alpha register to HPIL
                     loop. This will start the
                     Model 2200-12 counting.
LBL 01
INSTAT               Input status of Model 2200-12
FC? 05               Check counter ready bit.
GTO 01               If ready bit not set, check
                     status again.
"SR"                 Instruction to read scaler.
OUTA                 Output alpha register to HPIL
                     loop.
IND                  Input data from HPIL loop and
                     place in "x" register.
```

7.6 Set and Read outputs - The operation of this routine is similar to the HVS routine. The difference is the output number ranges from 1 to 8 and the data input will range from 0 to 255 as explained in the Command Description section.

```
LBL "OUTS"
"OS"
OUTA
CLA
ARCL X
OUTA
"OR"
OUTA
IND
```

7.7 Clear and Read Outputs - This routine operates identical to the OUTS routine.

```
LBL "OUTC"
"OC"
OUTA
CLA
ARCL X
OUTA
"OR"
OUTA
IND
```

7.8 Start Counter Routine - This routine will start the counter.

```
LBL "CNT"
"C"
OUTA
```

7.9 Read Remaining Count Time - This routine will read the remaining count time in tenths of minutes. Set the count time to 1 minute with the CNTS routine. Then start the counter with the CNT routine. Execute this routine repeatedly. The count time remaining will appear in the display.

```
LBL "CNTM"
"CT"
OUTA
IND
```

7.10 Stop Counter - To use this routine, start the counter with the CNT routine. Then execute this routine to stop the counter.

```
LBL "HOLD"
"H"
OUTA
```

7.11 Read External Inputs - This routine reads the external inputs and returns a number representing the input states as described in the command description section.

```
LBL "INPUT"
"IR"
OUTA
IND
```

7.12 Clear the Model 2200-12 and load the default settings.

```
LBL "CLEAR"
"CL"
OUTA
```

7.13 Set and Read Input Flags - The operation of this routine is identical to the HVS routine.

```
LBL "FLAG"
"FS"
OUTA
CLA
ARCL X
OUTA
"FR"
OUTA
IND
```

7.14 Set and Read Service Request Mask - The operation of this routine is identical to the HVS routine.

```
LBL "MASK"
"MS"
OUTA
CLA
ARCL X
OUTA
"MR"
OUTA
IND
```

7.15 Turn Stabilizer On.

```
LBL "STBON"
"SS"
OUTA
```

7.16 Turn Stabilizer Off.

```
LBL "STBOFF"
"SC"
OUTA
```

7.17 Read Software Version - Execute this routine and the software version will appear in the display.

```
LBL "VER"
"VR"
OUTA
INA
AVIEW
```