

INSTRUCTION MANUAL

S560

560 Series User Manual Issue 3 February 1989
S560 Series Instruments V1.9 or later

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1 GENERAL

1.1 Unpacking and inspection

Carefully unpack the instrument and perform a visual inspection. If there are any signs of damage, particularly if the packing is damaged, notify FGH Controls Ltd or your local distribution from whom the instrument was purchased and retain the original package.

Note that the series 560 instruments are supplied with a pair of DIN panel fixing clamps, be sure to remove these from the packing material.

1.2 Part numbering system

The 560 series consists of a range of instruments, all single loop process controllers. This user manual covers the entire 560 series, the various types of 560 are referred to by their type numbers and to assist the reader in identifying his particular instrument the part number coding is explained:

The 560 series part number consists of a sequence of characters grouped as follows: S56A-B-C-D. These have the following meaning.

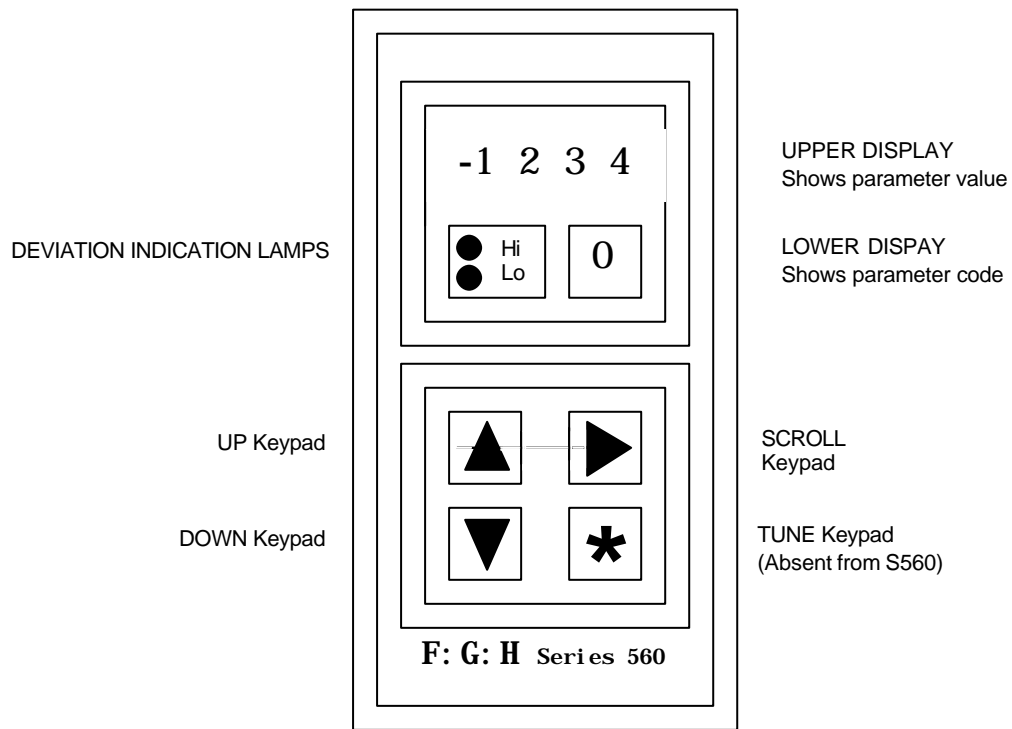
A = 0 for non-communicating controller
1 for communicating controller

B = 01 for type S Thermocouple °C
02 R
03 J
04 K
05 T
06 E
07 B
08 N
09 RTN (-199.9 to +199.9°C)
10 RTL (0 to +399.9°C)
11 RT (-100 to +1000°C)
12 LN (linear voltage or current)
13 for type S Thermocouple °F
14 R
15 J
16 K
17 T
18 E
19 B
20 N

C = 1 for time-proportional relay O/P
2A for continuous current 4-20mA
2B for continuous current 0-20mA
2C for continuous current 1-5mA
2D for continuous current 0-5mA
3 for time-proportional logic O/P
4 for time-proportional SSR O/P

D = 1 for 120V operation
2 for 240V operation

1.3 S560 Front Panel



Upper display: This display normally shows the measured value, when the instrument is in its scroll mode it shows the value of the scrolled parameter. This display defaults to the measured value if not action is taken in the scroll mode for approximately 18 seconds.

Lower display: This display is normally blank, when the instrument is in its scroll mode it shows a single number indicative of the particular parameter currently being scrolled. This display defaults to blank if no action is taken in scroll mode for approximately 18 seconds

'HI' LED : When steady indicates a HIHI deviation from setpoint. When flashing indicates a HI deviation from setpoint.

'LO' LED : When steady indicates a LOLO deviation from setpoint. When flashing indicates a LO deviation from setpoint.

'-' LED : This indicates that the data currently displayed is negative.

'UP' Keypad : This allows the value of a parameter to be incremented when the instrument is in its scroll mode.

'DOWN' Keypad : This allows the value of a parameter to be decremented when the instrument is in its scroll mode.

'SCROLL' Keypad : This allows entry to the instruments scroll mode and will present each parameter in turn for each keystroke. When all parameters have been scrolled the displays revert back to normal upon the next keystroke.

'STAR' Keypad : This button is used to activate TUNE-AID.

2 MOUNTING and ELECTRICAL CONNECTIONS

2.1 Panel mounting

The instrument is designed to fit into a DIN standard cutout of 92 (+0.8 –0.0) mm high, by 45 (+0.6 –0.0) mm wide. To fit the instrument into the panel, first of all remove the two panel clamps and slide the instrument into the cutout. From the rear of the panel, re-attach the panel clamps and slowly tighten the clamping screws until they begin to slip.

2.2 Power connections

The power terminal block is clearly marked LINE, NEUTRAL and EARTH. All 560 series instruments incorporate a mains input filter, to ensure correct and safe operation it is essential that the supply be connected correctly and that the instrument is earthed at all times.

2.3 Sensor connections

The sensor is either thermocouple, resistance thermometer, voltage or current: For thermocouple inputs terminals 7 and 9 are not used. For resistance thermometers the wires from terminals 7 and 8 join at the resistance thermometer thus completing a "3 wire connection". For voltage and current inputs terminals 8 and 9 are not used.

Terminal No.	T/C	RT	LINEAR
6	TC+	RT1	V+ or I+
7	NC	RT2	V- or I-
8	TC-	RT3	NC
9	NC	NC	NC

2.4 Output connections

Terminal No.	TP relay	TPL or I	SSR
3	Relay contact	I+	Line
4	Relay contact	I-	Load

When wiring the instrument, the low voltage wires (sensor and current output) should be segregated as far as possible from the high voltage wiring so as to minimise the chance of electrical noise pick-up.

Note The output relay contacts of the 560 series instruments are arc suppressed by means of an R-C snubber network. This reduces the level of RF interference and protects the contacts from excessive erosion when they are used to switch loads that are significantly inductive (e.g. relay and contactor solenoids).

The removal of this snubber can result in a serious hazard.

FGH Controls Ltd does not accept any responsibility for any damage which may result from the unauthorised removal of the snubber.

When the contacts are used to switch contactors or relays with very low operating currents then, in some cases, the small (approx 3mA) current which flows through the snubber when the relay contacts are open may be sufficient to keep the contactor energised. In these cases a solution is to wire a high wattage resistor in parallel with the contactor solenoid. A resistor of 10K ohms rated at 10W should restore correct operation of the contactor.

2.5 Communications connections

Instruments fitted with serial communications have an additional connector which is recessed behind a cutout at the rear of the instrument. In order to connect to this a 9 way female 'D' connector and cover is supplied which will plug in through the cutout.

The connector should be wired as follows.

PIN	20 mA Loop Function
1	Receive +
2	Receive -
3	Not used
4	Transmit +
5	Transmit -

3. OPERATIONS CONTROL

3.1 Operators scroll parameters

The list of user changeable parameters is termed the scroll. These parameters are called for one at a time by successive keystrokes of the scroll keypad. The number of parameters actually available to the operator is programmed in under engineers mode and all of the following assumes that the "password facility" available on the instrument has been disabled, for information on this facility refer to section 4.

Param Code	Meaning
1	SETPOINT (display only if remote setpoint used)
2	Output power: 0.0 to 100.0%
3	PROP BAND: 0.1 to 100.0% of the sensor range OR 0 to -100 indicates ON/OFF control hysteresis.
4	Integral action time: 0 (off) and 10 to 1800 seconds
5	Derivative action time: 0 (off) and 5 to 600 seconds
6	Approach band: The band in which derivative action can occur. Settable between 3.0X and 0.2X proportional band.
7	Output power limit: 0 to 100%
8	Time proportional output cycle time: 2 to 500 seconds

4. ENGINEERS SET UP MODE

560 series instruments are fitted with a second scroll sequence which is not normally available and is the operator. This scroll is called engineers mode and is used for the initial setting up of the instrument. The instrument is set up at the factory to the customers requirements and should not need changing, but should the user wish to change the instruments characteristics then proceed as follows:

Engineers mode is initiated by first cycling the instruments power. When first powered up the instrument will display '560' for approximately 5 seconds. During this period press the scroll and up keys simultaneously. The HI and LO deviation lamps will illuminate while EMODE is active and the S560 will allow the engineer to enter the setting up parameters.

It should be noted that whilst engineers mode is invoked the instruments output is switched off and the serial communications are inactive.

4.1 Engineers scroll

0	Input sensor:	
	1 =	Type S thermocouple in °C
	2 =	R
	3 =	J
	4 =	K
	5 =	T
	6 =	E
	7 =	B
	8 =	N
	9 =	Type RTN resistance thermometer
	10 =	RTL
	11 =	RT
	12 =	Linear
	13 =	Type S thermocouple in °F
	14 =	R
	15 =	J
	16 =	K
	17 =	T
	18 =	E
	19 =	B
	20 =	N

If the input sensor type number is changed then the following 3 parameters are preset with the normally expected values but can be changed if required.

- 1 HIN: The high value of the working range of the instrument. Also the span value for linear instruments
- 2 LIN: The lower value of the working range of the instrument. Also the zero value for linear instruments.
- 3 Decimal points position: By pressing the UP or DOWN keys the dp position can be moved as desired.

- 4 Output configuration code:
- 0 = Reverse acting, current output
 - 1 = Reverse acting, time proportional output
 - 2 = Forward acting, current output
 - 3 = Forward acting, time proportional output
- 5 Communications configuration code: 3 digit number from 100 to 699.

First digit

- 1 = 110 Baud
- 2 = 300 Baud
- 3 = 600 Baud
- 4 = 1200 Baud
- 5 = 2400 Baud
- 6 = 4800 Baud

Second and third digits:

Comms address 00 to 99

- 6 Inner (flashing) deviation alarm setting: 1 to 100 digits
- 7 Outer (steady) deviation alarm setting: Settable from the inner alarm level, up to 200 digits.
- 8 Password: This is the password teach element. Key in the desired password between 1 and 199. If no password and hence no security is required then set to zero.
- 9 The security level which define the number of that scroll element up to which operator access is allowed. If put equal to zero then no access is allowed without the correct password, if put equal to 1 then access is allowed to the first scroll element but not to any other, and so on.

Once the user has set these parameters to the required value, simply cycle the power to the instrument and after the initial 5 second period it will return to its normal working mode.

If the instrument range was changed while un engineers mode, it is now advisable to enter the controller scroll and check the control parameters. This is necessary because a change performed in engineers mode can completely change the characteristics of the instrument. For example if the value of Hin or Lin was changed then this will effect the resolution of the proportional band and may place some parameters e.g. Setpoint out of range, similarly a change from a deg C to a deg F.

4.2 Setting up linear ranges

Assume that we wish to connect a pressure transducer to an S560 and the transducer gives an output of 4-20mA equivalent to 0 to 30 psi. The instrument is required to display 0.0 to 30.0 over the range of the sensor.

First of all the input circuit of the instrument should be set to the 20mA range (this is factory set).

Set the input sensor code to type 12 (linear) and the decimal point to the correct position. This tells the instrument that's its input is a linear signal and that in this case we wish the decimal point to be displayed.

It is then necessary to tell the instrument that its input is equivalent to 0 to 30.0 psi. This is done using the scroll parameters Hin and Lin. In this case Hin should be set to 300 and Lin to -75 (-75 is the reading that would be given should the input current ever fall to 0 mA).

4.3 Flashing displays

Flashing upper display.

If the upper display is seen to be flashing or displaying 9999, this indicates that the controller has detected an internal memory error. In this state the control will be turned off and the controller will be inactive.

To restore normal working it is necessary to enter engineers mode and enter all the normally required values to set up the instrument. It is then necessary to enter calibrate mode and re-calibrate the instrument (if the set calibration figures were noted down at the time of calibration, it is merely necessary to re-enter these values).

Once the engineers and calibrate mode have been set up, enter the controller scroll and enter the previously set control terms.

Flashing lower display

A flashing lower display indicates that the self tuning procedure TUNE-AID is in progress and the controller is deducing a new set of control terms. See section 6 for further details.

4.4 Deviation indication lamps

The 560 series controllers are equipped with two yellow deviation indication lamps on the front panel. The purpose of these lamps is to provide 'at a glance' indication to the operator that the process is not a setpoint. The operator need only quickly scan a row of instruments, a yellow lamp immediately drawing his attention to a possible problem.

The upper (HI) lamp indicates that the process variable is above setpoint and the lower (LO) lamp indicates that the process variable is below setpoint. The deviation lamps can be either steady, flashing or off. A steady lamp indicates a large error from setpoint, a flashing lamp indicates a small error from setpoint and both lamps off indicates that the error is acceptable

The points at which these lamps are triggered are fully programmable in engineers mode using parameters 7 and 7 (inner and outer deviation bands).

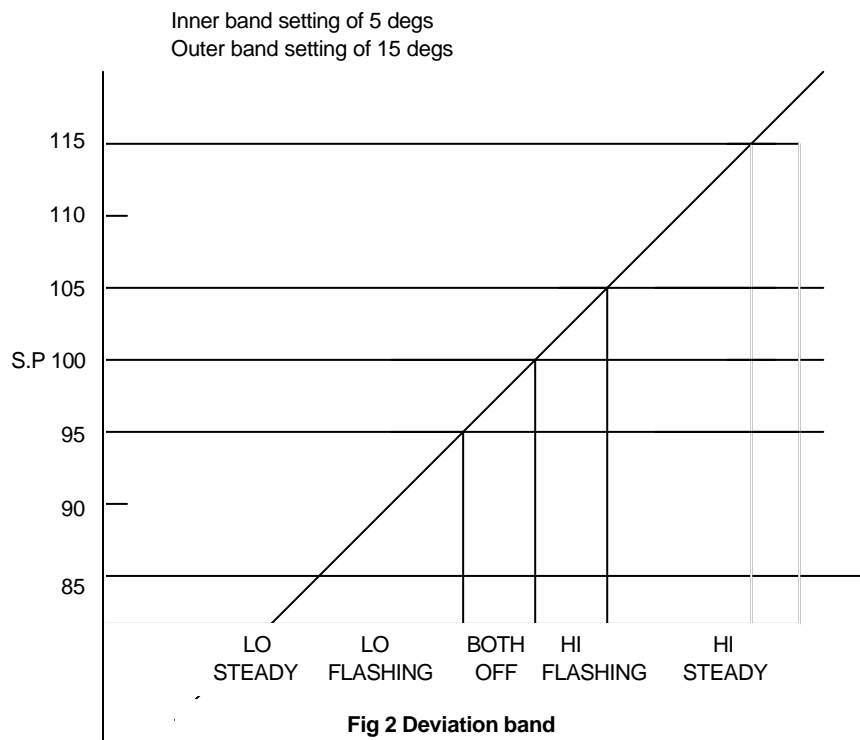
Inner deviation band

The inner deviation band parameter should not be set to the maximum acceptable error for the process. As long as the process error remains within the inner band setting the deviation lamps will remain off. Should the process variable excure outside this band then the relevant deviation lamp will immediately start to flash indicating a HI or LO deviation alarm. Should the error continue to increase then eventually the lamp will stop flashing and remain on when the outer deviation band is reached.

Outer deviation band

The outer deviation band is the band outside which the deviation lamps come on steady, and is therefore the HI-HI and LO-LO alarm level. The setting for this parameter must obviously be greater than that set for the inner band.

Refer to fig 2 for an example of deviation alarms.



5. CALIBRATION MODE

This scroll is a special scroll which is used to calibrate the controller without the necessity of removing the instrument from its case.

Calibration mode is invoked in a similar way to engineers mode. First cycle the mains power to the instrument. When the power is restored the instrument display will show '560' for approximately 5 seconds. During this period press the scroll and down keys simultaneously, the instrument will immediately switch to calibration mode. This mode is indicated by both the HI and LO deviation lamps flashing.

It should be noted that whilst calibration mode is invoked, the instruments output is switched off and the serial communications are inactive.

5.1 Calibration mode scroll parameters

Param Code	Meaning
1	ZERO SET: The upper display shows the measured value. Depression of the UP/DOWN keys will alter the instruments zero setting causing the MV value to change slowly.
2	ZERO READ: The upper display shows the theoretical position of the 'zero pot'. The UP/DOWN keys can be used to change this quickly if required.
3	SPAN SET: The upper display shows the measured value. Depression of the UP/DOWN keys will alter the instruments span setting causing the MV value to change slowly.
4	SPAN READ: The upper display shows the theoretical position of the 'span pot'. The UP/DOWN keys can be used to change this quickly if required.

5.2 Calibrating the instrument

Instrument calibration should only be performed by personnel who have previous experience of general instrument calibration.

Calibrating a thermocouple instrument

Disconnect the thermocouple from the rear of the instrument, and connect instead a precision millivolt source and ice point (the ice point can be omitted if the correction for ambient temperature is to be done manually).

Remove the TC type selector link from the input stage and select Type B thermocouple in Engineers mode.

Invoke calibration mode as described above and scroll onto parameter 1. Set the millivolt source to the equivalent of 200 degs C (178uV) and using the up and down keypads, adjust the zero until the instrument display reads 200.

Scroll on to parameter 3 and set the millivolt source to the equivalent of 1800 degs C (13585uV). Using the up and down keypads, adjust the span until the display shows 1800 degs.

Repeat the zero and span setting until no further adjustment is necessary.

Invoke engineers mode and set the range code to the preferred thermocouple type. Also select this type on the input selector links. Set the millivolt source to a few tens of degs above zero (using the correct CJ compensation) and adjust the CJC pot until the instrument reads correctly.

Calibrating an RT or Linear instrument

Resistance Thermometer instruments

Disconnect the RT from the rear of the instrument, and connect instead a precision resistance between terms 6 and 7, terminals 7 and 8 should be connected together at the resistance box.

Linear instruments

Disconnect the existing wiring to terminals 6 and 7 and connect instead a precision DC voltage or current source (terminal 6 is positive).

Procedure

All instruments should be at their normal working temperature before any attempt at calibration is made.

Invoke CMODE as described above and select scroll parameter 1. Set the dummy sensor to give an output equivalent to about 10 digits above the instruments zero value. Use the UP and DOWN keypads to move the displayed MV until it reads the correct value.

Scroll on to parameter 3 and set the dummy sensor unit to give an output equivalent to the span of the instrument. Use the UP and DOWN keypads to move the displayed MV until it reads the span value of the instrument.

Repeat the zero and span setting until no further adjustment is necessary.

Note down the value that the instrument displays for scroll parameters 2 and 4. These values are the internal zero and span calibration figures used by the instrument. Should the instrument detect an internal memory error resulting in loss of these values, the old values can then be entered directly by the use of scroll elements 2 and 4 eliminating the need for a re-calibration.

6. PASSWORD AND OPERATOR ACCESS

560 series instruments are provided with a unique security facility to prevent unauthorised changing of user entered data.

The normal controller scroll contains many parameters, some of which can radically change the way in which the controller behaves. Because of this it may be desirable to prevent operator access to some or all of these parameters and hence eliminate the chances of damage to the process. Two security parameters PASSWORD and SECURITY level are provided for this purpose and both of these are set up in engineers mode.

6.1 Teaching the S560 a new password

To teach the instrument a new password, invoke the engineers mode scroll as described earlier and scroll up to element 8. The currently set password will be displayed on the upper display. The password is a three digit number which can be set to any number between 0 and 999. This is the number which must be entered by the operator if he is to gain access to the full controller scroll. Select a desirable password number and enter this using the UP and DOWN keypads. If the password facility is not required then set the password to zero and exit from Emode. The next scroll element in engineers mode is SECURITY LEVEL. This parameter is used to control the number parameters to which the operator has access. If set to zero then no access at all is allowed. If set to 1 then the operator has access to the first scroll element only (setpoint). SEC may be set to allow the operator access to any number of parameters up to the maximum of nine. Once the password and security level have been set, exit engineers mode by cycling the power to the instrument.

6.2 Scroll operation with an active password

With the password active, normal use of the SCROLL keypad will only give the operator access to a limited number of parameters. For the engineer or supervisor to gain access to the remaining parameters the password must be entered. To enter the password the instrument must be in its 'normal' state showing the process variable on the upper display. Upon depression of the DOWN keypad, both displays will show zero. The instrument is now inviting the user to enter the password by means of the UP and DOWN keypads. Once the password has been entered correctly, depression of the SCROLL keypad will give full access to the controller scroll and the user is free to make any changes as required. When all changes are complete the display will revert back to its 'normal' mode approximately 20 seconds after the last key depression at which point the security lock will become active again. Further depressions of the SCROLL keypad will therefore only allow access to the restricted operators scroll.

7. SETTING THE CONTROLLERS TERMS

Arbitrary adjustment of the P, I and D terms by trial and error in an attempt to find the optimum conditions is at best time consuming and could result in a much poorer control than can be achieved by the use of the Tune-aid facility built into the 560 series of instruments.

7.1 Tune-aid

Tune-aid is an automatic means of deducing appropriate values for the proportional band, integral time and derivative times to suit the particular plant and process conditions: therefore all 560 series instruments have the Tune-aid facility fitted. Tune-aid is invoked manually from the instrument's front panel whenever the user requires, it does not operate continuously so as to modify the values of P I and D to suit changing process conditions. Tune-aid operates by causing the measured variable to oscillate or hunt about setpoint and from the magnitude and times of these oscillations it calculates appropriate values of P I and D. To perform these calculations certain assumptions have to be made which may not in fact be true for certain plant and process conditions; the resultant values of P I & D may therefore require further manual trimming in order to tune the process to meet the required performance. Since Tune-aid purposely causes the measured value to oscillate and since these oscillations could be of considerable amplitude, certain safeguards and interlocks have been built in so as to guard against the unauthorised use of Tune-aid and the attendant risk of damage to the users plant and product.

7.1.1 Use of Tune-aid

We will assume that we have no prior knowledge of the likely values of P I & D and that we are attempting to "tune" the plant for the first time. We will further assume that the process consists of a simple heating temperature control loop and that the initial measured value is some considerable amount below the setpoint, at or close to ambient temperature and that the heater power is off. First it is necessary to set the values of all the controller's parameters as follows:

Parameter	Value
Setpoint:	Set to a value some safe amount below the final set point to ensure that the peaks of the oscillations do not exceed the maximum of the plant
Prop band:	Set to an arbitrary 10.0%
Int time:	Set to OFF
Der time:	Set to OFF

Appr band: Set to the maximum of 3.0

Power Limit: Set to 100%

Cycle time: Set to a value appropriate for the heater control contactor

It is now only necessary to satisfy the 560's interlocks and Tune-aid can be invoked and values for P I & D determined, unfortunately Tune-aid gives the most appropriate values for P I & D if the measured value is already being controlled at the setpoint. In this case, therefore, we will use Tune-aid once in order to provide reasonable, albeit too large, values and then, once the measured value comes under control at the setpoint we will invoke it a second time to provide values of P I & D that are a better approximation to the optimum values.

To invoke Tune-aid scroll on until the setpoint is displayed and then press the STAR keypad the 560 will then begin to flash its lower display and continue to flash it all the while that Tune-aid is operating. Note that the lower display will show a flashing zero when the controller has relaxed to its normal mode.

Now switch the power on to the heater;

THE 560 WILL APPLY FULL POWER TO THE PROCESS UNTIL THE MEASURED VALUE REACHES SETPOINT.

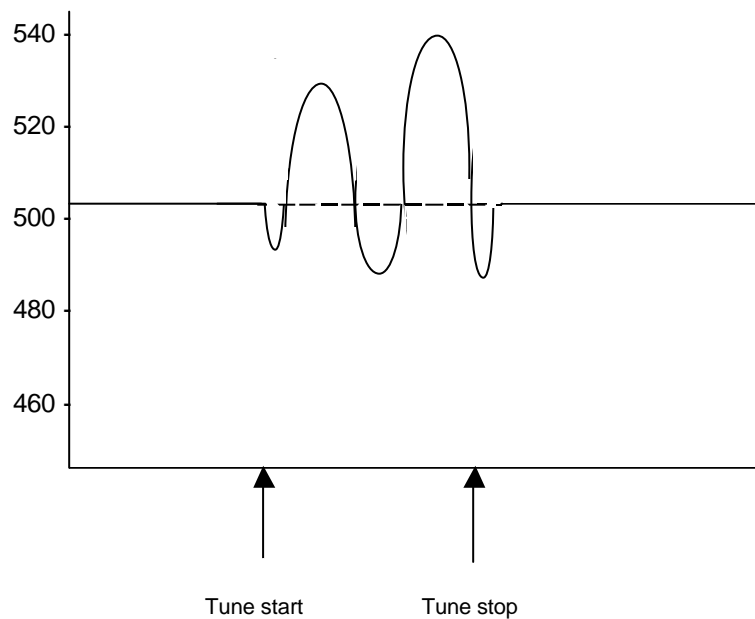


Fig. 5 Typical Tune-aid response

Once set point is reached the 560 turn the power off and the measured value overshoots and then falls below set point whereupon full power is once again applied to the process. The measured value is thereby caused to oscillate about set point until the fifth crossing of setpoint, at which point the values of P I & D are calculated and entered into the controller. It is at this point that the flashing lower display terminates and the measure value will be brought under control at the setpoint. Once it can be seen that conditions have stabilised with the measured value at the set point then Tune-aid may be invoked again so as to give better values for P I & D. Scroll on to the setpoint and press key-pad 4 again. The oscillations of measured value will this time be somewhat smaller and give the best values for P I & D that Tune-aid can deduce for this plant and these process conditions.

Tune-aid provides approximate parameters only and errs on the side of stability. If it is found the value of power limit is inappropriate, then further manual trimming of P I & D may be necessary to achieve the desired control performance.

If initial values for P I & D are already approximately known then these values may be entered initially and the measured value allowed to reach and stabilise at set point, Tune-aid need only then be invoked once with the much reduced oscillations of measured value.

7.1.2 Aborting Tune-aid

If Tune-aid is in progress and for whatever reason it is found necessary to cancel Tune-aid then this can be done either by:

- a) Changing the value of the setpoint whilst Tune-aid is running.
- b) Changing the value of the proportional band.

Any of the above actions will terminate Tune-aid and restore the control terms to their previous values.

7.2 Manual determination of P I & D

If, for whatever reason, the method of tuning employed by Tune-aid is unsuited to a particular plant or process condition then the following manual method, attributable to Messrs Ziegler and Nicholas, may be employed.

7.2.1 Proportional band

It is necessary to determine the largest value of proportional band which in sustained, constant amplitude oscillation (hunting) of the process being controlled.

Set the setpoint at a value appropriate to the process, set the integral and derivative times to (off), the approach band to 1.0 and begin with the prop band set at a value high enough to guarantee that the measured value will not oscillate. Allow the process to reach setpoint and closely observe the measured value MV. Then gradually begin to reduce the value of the prop band in steps and, at each step, introduce a small disturbance to the process so as to "jar" the system into hunting. Continue in this way until a setting of prop band is found where the hunting or oscillations are of a constant amplitude, neither increasing or reducing. Note that the process may hunt with a period of several minutes, so allow sufficient time at each setting to be sure if the hunting is steady or reducing. A generally satisfactory value of prop band will be twice that setting which just results in sustained hunting.

7.2.2 Integral and Derivative Times

Reduce the prop band to a value which just results in sustained hunting and if necessary introduce a small disturbance to setpoint in order to start the hunting. When hunting is occurring carefully time the period between successive maxima of measured value. A generally satisfactory value of integral will be half of this period so set the integral term accordingly. A generally satisfactory value of derivative will be one eighth of this period so set the derivative term accordingly.

If the process does not hunt even with the prop band set to 0.1% then proceed as follows:

Leave the prop band set at 0.1%. Increase the derivative time to its smallest value and then introduce a small disturbance to the setpoint, observe the MV and decide if the transient response is satisfactory, if not then increase the derivative time to progressively larger and larger values until the transient response is satisfactory. Now set the integral term to its maximum and then to successively smaller and smaller values until a point is reached where hunting is seen to begin, at this point double the setting of integral.

An approach band setting of 1.0 only allows the derivative action to come into operation within 1.0 x the proportional band, in certain circumstances this may result in an undesirable overshoot under start-up conditions. Where greater overshoot inhibition is required then the approach band should be increased to allow the derivative action to come into operation whilst measure value is further away from the setpoint, this will however increase the time from start-up before the setpoint is reached.

8. SERIAL COMMUNICATION

8.1 Word format and message structure

Communications with the S560 is by means of a full duplex 20mA loop. The instruments terminals are passive and therefore loop power must be provided by the device with which the 560 is communicating. Communication is in asynchronous serial form using ASCII characters at either 110, 300, 1200, 2400 or 4800 Band.

The character format is: 1 start bit
7 data bits
1 odd parity bit
1 stop bit.

The message format is: ABBCCDEEEEF

Where A = message header
BB = S560 address
CC = parameter code
D = units of data
EEEE= data field
F = ASCII carriage return (cr)

The meaning and signification of these is explained as follows:

8.1.1 Message Header

This may be either ASCII R signifying a Read instruction
ASCII W signifying a Write instruction

The R header is used whenever data is to be read from the instrument and the W header is used whenever the value of a parameter is to be changed.

8.1.2 Address

Usually more than one instrument will be sharing the communication loop, each instrument must be set to a different address (see section 5) to enable a message to be directed to one (and only one) instrument at a time. The address field of the message determines to which instrument the message is addressed. The address of an S560 may be any number from 00 to 99 inclusive. Either digit in the address field may be replaced by the wild character 'X'. For example an address field of X5 will address all 560s whose address ends with the figure 5, 6X will address all 560s whose address field starts with the figure 6. XX will simultaneously address all instruments whatever their address. When using wild addressing the 560s will obey the incoming message, provided it is not in error, but will not generate a reply.

8.1.3 Parameter codes

The various parameters within the instrument are each assigned a code consisting of a single alpha character.

<u>Code</u>	<u>Meaning</u>	<u>Read Only</u>
A	Measured value	YES
B	O/P power 1/10%	YES
C	Local setpoint	NO
D	Prop band in 1/10%	NO
E	Integral time in sec	NO
F	Derivative time in sec	NO
G	Approach band in 1/10%	NO
H	Power limit in %	NO
I	TP cycle time in sec	NO
N	Resultant setpoint	YES
Q	Instrument type code	YES
@*	Comms remote setpoint	NO

* The @ parameter code is used to read or write a remote comms setpoint to the S560. When accessed via this parameter code, the instrument switches to remote setpoint mode and disables setpoint entry from the front panel. The instrument will return to local setpoint mode if unpowered.

8.1.4 Data

When writing to the instrument the data field must contain the new value of the parameter, this must be four digits except when the data is negative in which case the four digit data should be prefixed with a minus sign. The data field must contain data within the valid range for the parameter, data outside this range will not be accepted by the instrument and will result in the generation of an error message. The valid ranges are as follows:

8.1.5 Valid data ranges

The following table shows the valid range of data that may be written to each parameter.

- A Sensor zero to span
- B 0000 to 1000
- C Sensor zero to span

- D -10to 1000
- E 0000 to 1800
- F 0000 to 0600
- G 0002 to 0030
- H 0000 to 0100
- I 0002 to 0500
- @ Sensor zero to span

8.2 Status data codes

The instrument type data field for parameter 'Q' is abbc where:

- a = always 1
- bb = 01 for T/C type S
02 for T/C type R
03 for T/C type J
04 for T/C type K
05 for T/C type T
06 for T/C type E
07 for T/C type B
08 for T/C type C
20 for TR
21 for RTL
22 for RTN
30 for UAV
31 for LN
- c = always 1

8.3 Examples of messages

The following are examples of messages to the instrument and its reply which illustrates much of the above.

To read the measured value of instrument address No.3 the message to the instrument is:

R03A (cr)

The instrument responds:

*** 03 A 0234 (cr)**

Where * = Message understood
 03 = Address
 A = Code for measured value
 0234 = Data, measured value is 234

To read the same instruments proportional band the message its:

R03D (cr)

The instrument responds:

*** 03 D 0056 (br)**

Where 0056 = Data, prop band is 5.6%

To write a new prop band of 5.0% the message is:

W03D0050 (cr)

The instrument responds:

*** 03 D 0005 (cr)**

Which signals that the message was understood and the instruction has been carried out.

8.4 Error codes and messages

Where the instrument cannot act on the message then the instrument responds with a message of the form:

? 03 YY (cr)

Where:

? = Message not understood
03 = Address
YY = An error code whose binary weighting is as follows:

Bit 7: Illegal trailer
Bit 6: Tx buffer overflow
Bit 5: Illegal No. of character
Bit 4: Illegal data
Bit 3: Illegal parameter code
Bit 2: Rx buffer overflow
Bit 1: Illegal header
Bit 0: Not used.

Where the instrument detects that the received message has been corrupted in transmission then it responds:

? 03 Z (cr)

Where:

? = message not understood
03 = Address
Z = an error code whose meaning is as follows:

P = Parity error
F = Framing error
O = Receiver overrun error
(This means that another character was received before the instrument had time to act on the first one.)

APPENDIX A

Thermocouple Range changing

The thermocouple type is set up in 2 places on the instrument, the input range code is set in Engineers mode (see section 4).

The cold junction compensation however must be set up manually by selecting the correct link on the main printed circuit board. To perform this change proceed as follows.

1. Switch off the power and remove the instrument from the panel
2. Undo the two case lid retaining screws and remove the lid from the instrument.
3. Examine figure 4 and locate the T/C Type selector links near the rear of the instrument. Remove the jumper link from its present position and fit it to the correct pins for the new range.
4. Replace the lid and screws and refit the instrument into the panel.

B Thermocouple Burnout selection

The burnout direction for the thermocouple is set up by means of a link on the main printed circuit board. To perform this change proceed as follows.

1. Switch off the power and remove the instrument from the panel
2. Undo the two case lid retaining screws and remove the lid from the instrument.
3. Examine figure 4 and locate the burnout selector links near the rear of the instrument. Remove the jumper link from its present position and fit it to the correct pins for the new range. If no burnout is required leave all three pins unconnected.
4. Replace the lid and screws and refit the instrument into the panel.

