

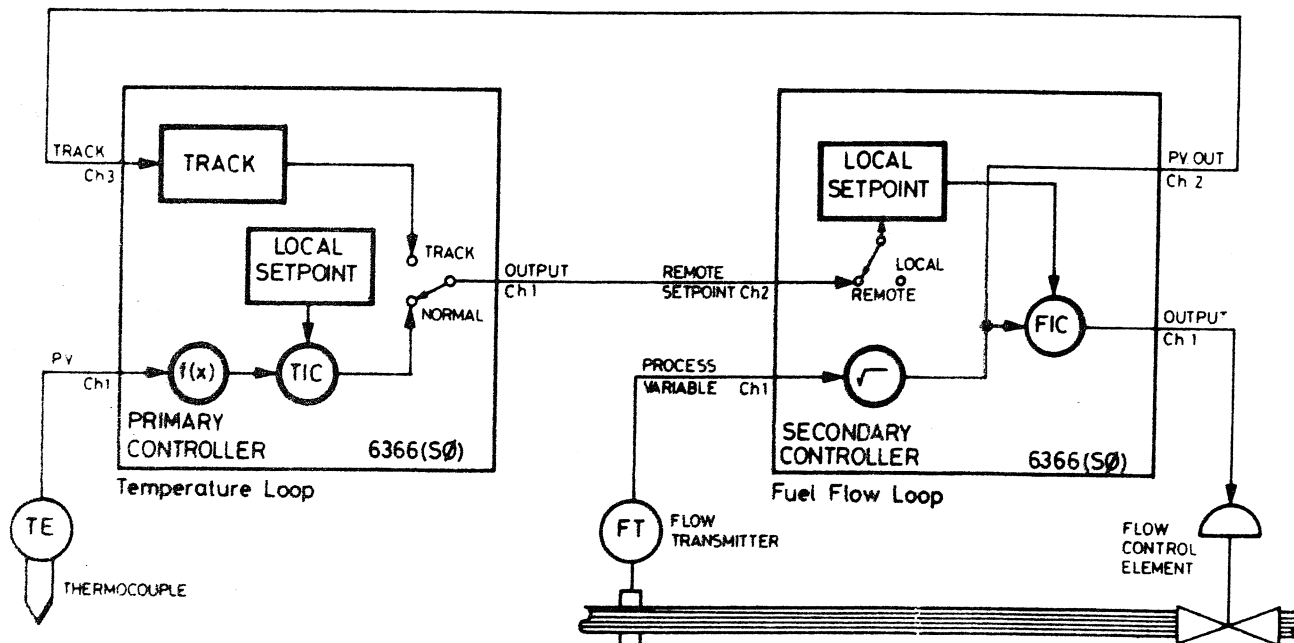
Programmable Advanced Controller

6366

Applications Library

Number 001

SINGLE LOOP CONTROLLER (LOCAL/REMOTE SETPOINT) SØ



Single Loop Controller (Cascade Controller)

The example shows a process temperature being controlled through a secondary fuel flow loop using two 6366 controllers. To effect bumpless and procedureless switching between Remote, Auto and Manual on the secondary controller, its Process Variable is retransmitted to the primary controller. This allows the output of the primary controller to track the Process Variable of the secondary controller whenever it is in Manual.

The loop setpoint of the secondary controller will track the remote setpoint value as long as it is in Remote. In addition, an option allows the local setpoint of each controller to track its own Process Variable while it is in Manual.

Applications

Single Loop Integrity
Combustion Control
Boiler Control
Furnace Control
Gas Pressure Control

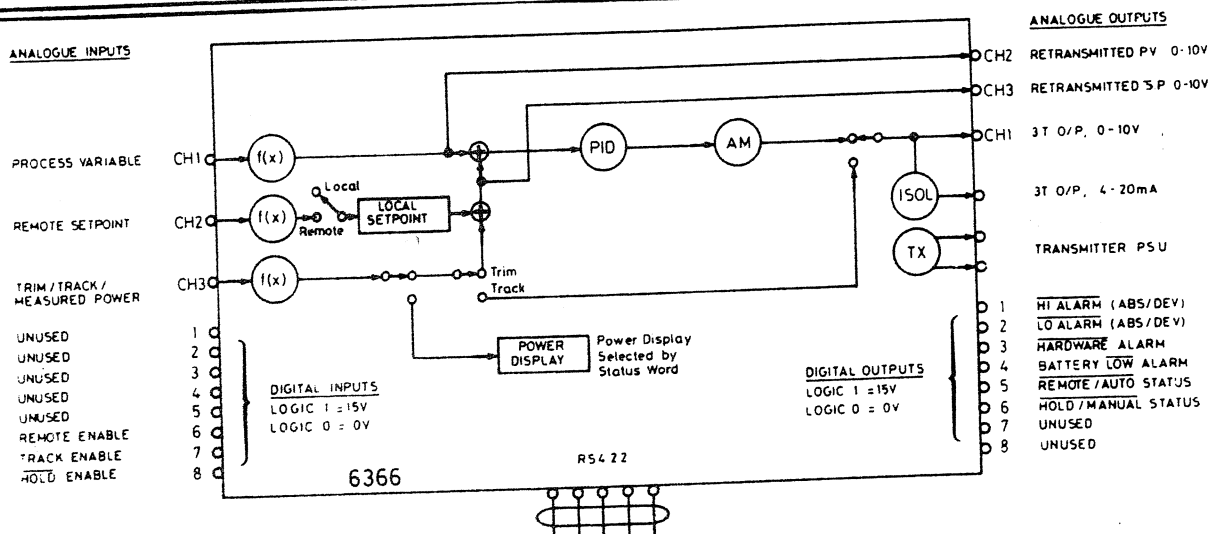
Glass Furnace/Forehearth
Reheat Furnaces
Blast Furnaces
Chemical Reaction Vessels
Cement Drying

Further Information

Further data may be found in the following Manuals:

6366 Technical Manual.
6366 Programming Manual.
6366 Applications Manual.

Applications Program



Program Listing

S0 (Standard controller configuration)
 TRACK1 (Set up track register)
 TRIM1 (Set up trim register)
 REMOTE1 (Set up remote setpoint register)
 PV1 (Stack process variable)
 PID1 (Stack PID output)
 SETOP1 (Store PID output)

Summary of Configuration Parameters

Block	Block	Block	Refly	Block	Parameter Number															
Description	Mntrc	Type	Block	No	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
General Purpose	GP	0	1	0	ST	II	LI	L2	BG	SW	PB									
Analogue Input	AI	1	1	1	ST	HR	LR	AI	AV											
			2	2	ST	HR	LR	AI	AV											
			3	3	ST	HR	LR	AI	AV											
Analogue O/P	AO	2	1	4	ST	HR	LR	HL	LL	AO										
Digital Input	DI	3	1	5	ST	XM	DS													
Digital O/P	DO	4	1	6	ST	WM	DS													
Setpoint	SP	5	1	7	ST	HR	LR	HL	LL	PV	SP	ER	SL	SR	SB	RL	HA	LA	HD	LD
PID Control	3T	7	1	11	ST	XP	TI	TD	FF	FB	OP	TS								
Manual Output Station	MS	8	1	13	ST	HV	LV	HL	LL	AO	OP	OT								
			2	14	ST	HV	LV	HL	LL	AO	OP	OT								
Display & Control	DC	9	1	15	ST	IB	2B	3B	DD	ES	SM									

Background Programs

- B0 Power up in last mode with last out. O/C input forces Manual mode with last output.
 B1 Power up in Manual with output low limit. O/C input forces Manual Mode with last output.
 B2 Power up as B0 but O/C input forces Manual with low output.
 B3 Power up as B1 but O/C input forces Manual with low output.

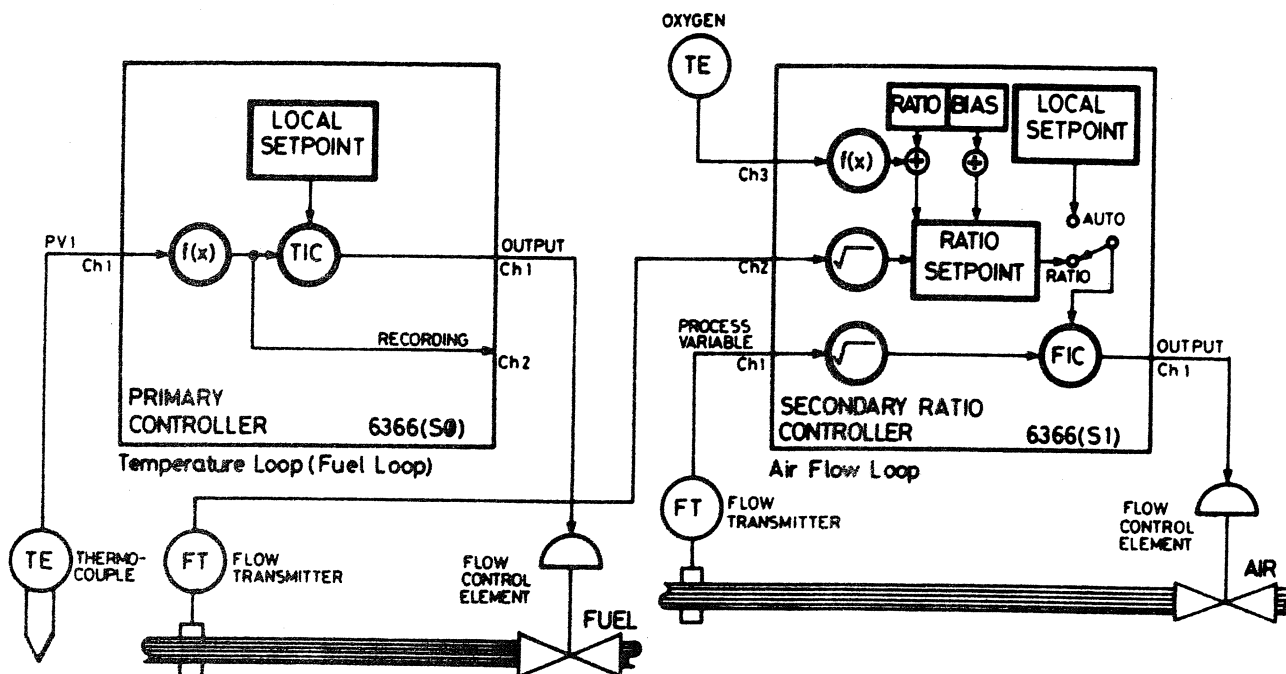
Programmable Advanced Controller

6366

Applications Library

Number 002

SINGLE LOOP CONTROLLER (RATIO CONTROLLER) S1



Single Loop Controller (Ratio Control)

The fuel-air control system illustrated demonstrates several features of the 6366 Programmable Advanced Controller. The furnace temperature controller regulates the fuel flow and makes the linearised process temperature available for recording. The fuel flow is measured and linearised within the combustion air controller

where the ratio bias functions are executed to generate the correct setpoint to maintain the desired relationship between fuel and air flows. The combustion air controller also linearises an input from an oxygen monitor and uses this to trim the ratio setting to ensure efficient combustion.

Applications

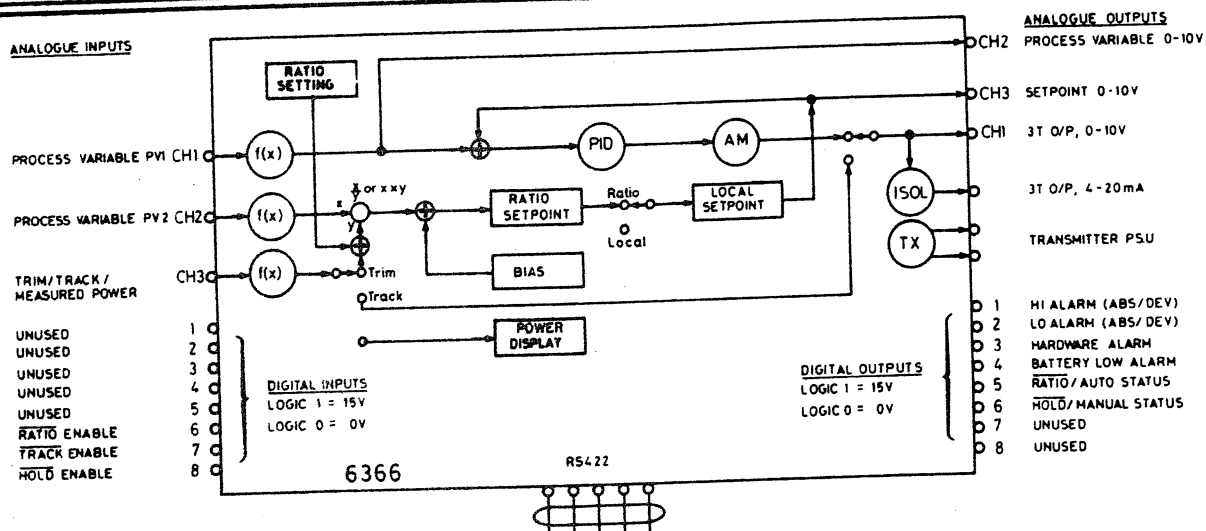
Furnace Combustion
Boiler Control Systems
Dryers

Further Information

Further data may be found in the following Manuals:

- 6366 Technical Manual.
- 6366 Programming Manual.
- 6366 Applications Manual.

Applications Program



Program Listing

S1 (Ratio controller configuration)
 TRACK1 (Set up track register)
 RATRIM1 (Set up ratio setting trim register)
 RATIO1 (Calculate setpoint from ratio PV)
 PV1 (Stack process variable)
 PID1 (Stack PID output)
 SETOP1 (Store PID output)

Summary of Configuration Parameters

Block	Block	Block	Ref	Block	Parameter Number															
Description	Block	Type	Block	No	9	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
General Purpose	GP	0	1	0	ST	II	L1	L2	BG	SW	PB									
Analogue Input	AI	1	1	1	ST	HR	LR	AI	AV											
			2	2	ST	HR	LR	AI	AV											
			3	3	ST	HR	LR	AI	AV											
Analogue O/P	AO	2	1	4	ST	HR	LR	HL	LL	AO										
Digital Input	DI	3	1	5	ST	XM	DS													
Digital O/P	DO	4	1	6	ST	WM	DS													
Setpoint	SP	5	1	7	ST	HR	LR	HL	LL	PV	SP	ER	SL	SR	SB	RL	HA	LA	HO	LD
Ratio	RB	6	1	8	ST	HR	LR	RS	RT	RB										
PID Control	3T	7	1	11	ST	XP	TI	TD	FF	FB	OP	TS								
Manual Output Station	MS	8	1	13	ST	HV	LV	HL	LL	AO	OP	OT								
			2	14	ST	HV	LV	HL	LL	AO	OP	OT								
Display & Control	DC	9	1	15	ST	IB	2B	3B	DD	ES	SM									

Background Programs

B0 Power up in last mode with last out. O/C input forces Manual mode with last output.
 B1 Power up in Manual with output low limit. O/C input forces Manual Mode with last output.
 B2 Power up as B0 but O/C input forces Manual with low output.
 B3 Power up as B1 but O/C input forces Manual with low output.

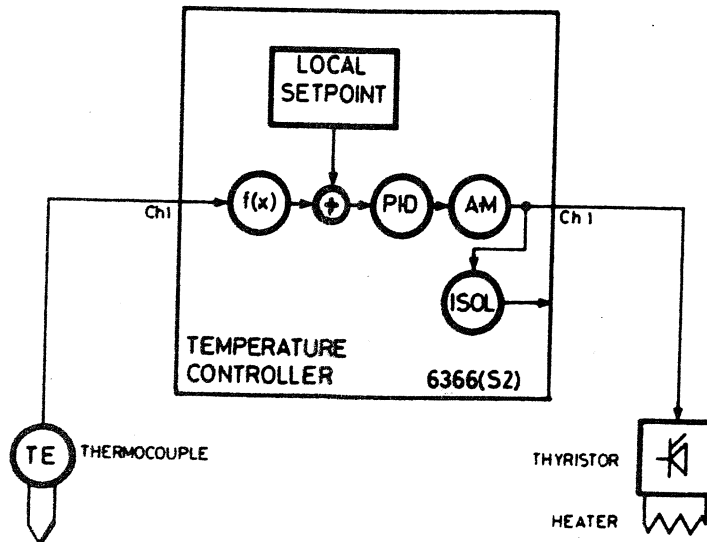
Programmable Advanced Controller

6366

Applications Library

Number 003

SIMPLE SINGLE LOOP CONTROLLER S2



Simple Single Loop Controller

The example shows a simple PID controller with 0-10V (1-5V) input, linearisation of the measurement, local setpoint, Auto/Manual station and 0-10V and 4-20mA outputs.

S2 may be used in conjunction with S3 to produce a 2-loop controller and is designed as a basic building block for user applications.

Applications

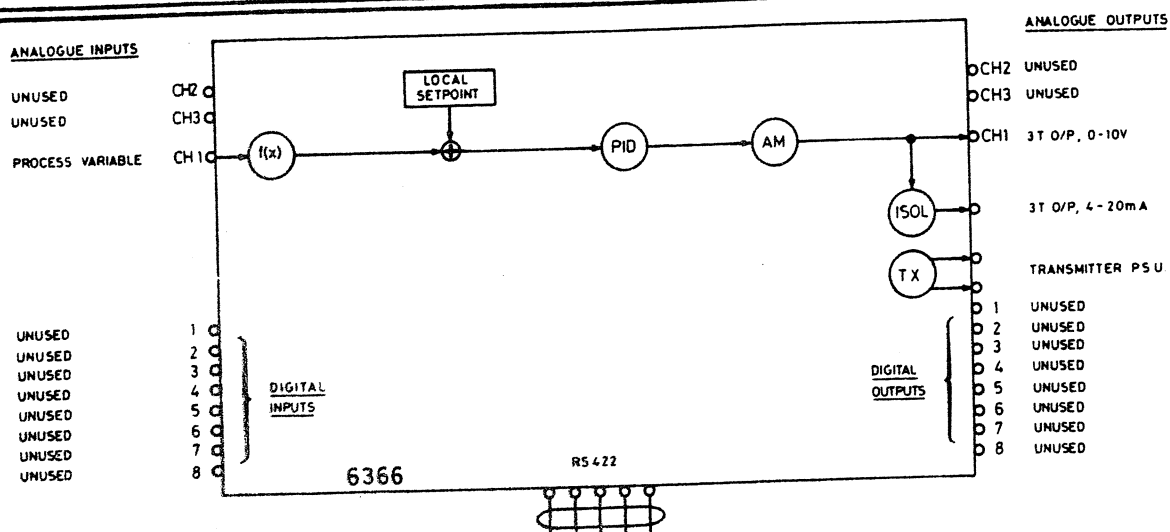
Simple Loop Process Control
Dual Loop Process Control
Multi-zone Ovens
Multi-zone Forehearths
Multi-zone Furnaces
Multi-zone Dryers

Further Information

Further data may be found in the following Manuals:

6366 Technical Manual.
6366 Programming Manual.
6366 Applications Manual.

Applications Program



Program Listing

S2 (Simple PID loop 1)

PV1

PID1

SETOP1

Summary of Configuration Parameters

Block Description	Block Minirc	Block Type	Refly Block	Block No	Parameter Number																
					B	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	
General Purpose	GP	0	1	0	ST	II	L1	L2	BG	SW	PB										
			1	1	ST	HR	LR	AI	AV												
Analogue Input	AI	1																			
Setpoint	SP	5	1	7	ST	HR	LR	HL	LL	PV	SP	ER	SL	SR	SB	RL	MA	LA	MD	LD	
PID Control	3T	7	1	11	ST	XP	TI	TD	FF	FB	OP	TS									
Manual Output Station	MS	8	1	13	ST	MV	LV	HL	LL	AO	OP	OT									
Display & Control	DC	9	1	15	ST	IB	2B	3B	DD	ES	SM										

Background Programs

B5 Power up in last mode with last output.
 O/C P.V. causes Hold mode while condition exists.
 Hi/Lo alarms are not displayed. (Registered in Communications Alarm state only).

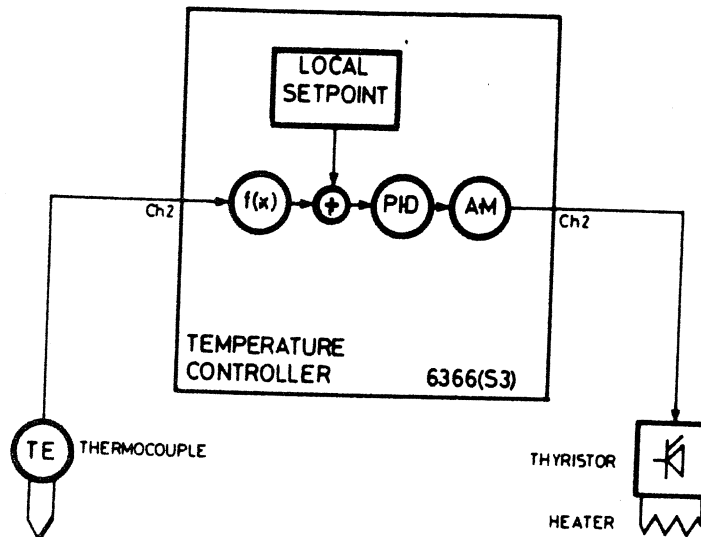
Programmable Advanced Controller

6366

Applications Library

Number 004

SIMPLE SINGLE LOOP CONTROLLER S3



Simple Single Loop Controller

The example shows a simple PID controller with 0-10V input, linearisation of the measurement, local setpoint, Auto/Manual station and 0-10V output.

S3 may be used in conjunction with S2 to produce a 2-loop controller and is designed as a basic building block for user applications.

Applications

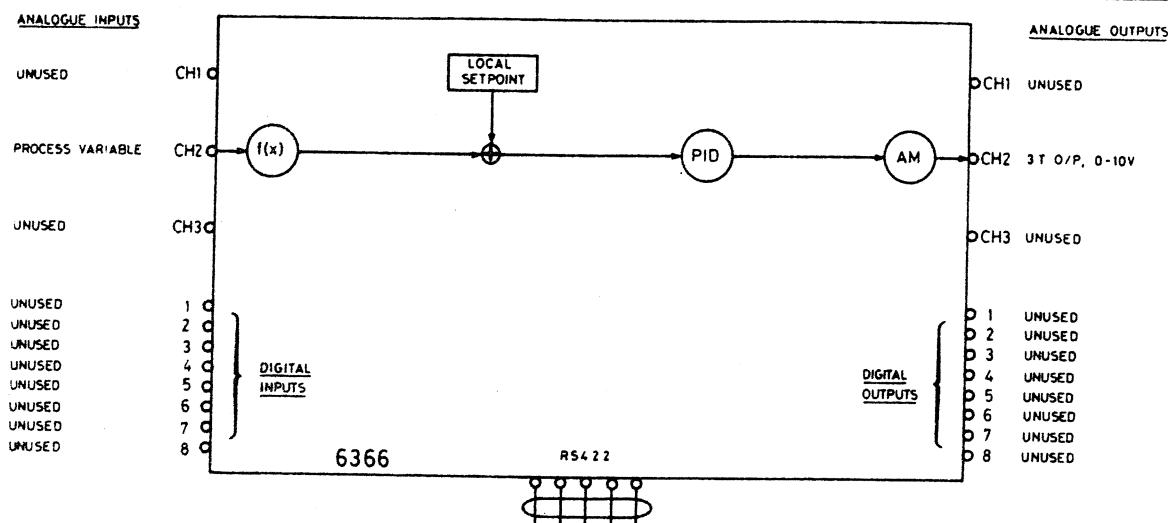
Simple Loop Process Control
Dual Loop Process Control
Multi-zone Ovens
Multi-zone Forehearths
Multi-zone Furnaces
Multi-zone Dryers

Further Information

Further data may be found in the following Manuals:

6366 Technical Manual
6366 Programming Manual
6366 Applications Manual

Applications Program



Program Listing

S3 (Simple PID loop 2)
 PV2
 PID2
 MS2 MSCONT

Summary of Configuration Parameters

Block Description	Block Minic Type	Block Type	Ref/Block Block No	Parameter Number															
				0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
General Purpose	GP	0	1	0	ST	II	L1	L2	BG	SW	PB								
Analogue Input	AI	1	2	2	ST	HR	LR	AI	AV										
Setpoint	SP	5	2	8	ST	HR	LR	ML	LL	PV	SP	ER	SL	SR	SB	RL	MA	LA	MD
PID Control	3T	7	2	12	ST	XP	TI	TD	FF	FB	OP	TS							
Manual Output Station	MS	8	2	14	ST	HV	LV	HL	LL	AO	OP	OT							
Display & Control	DC	9	2	16	ST	IB	2B	3B	DO	ES	SM								

Background Programs

B5 Power up in last mode with last output.
 No O/C detection.
 Hi/Lo alarms not displayed.

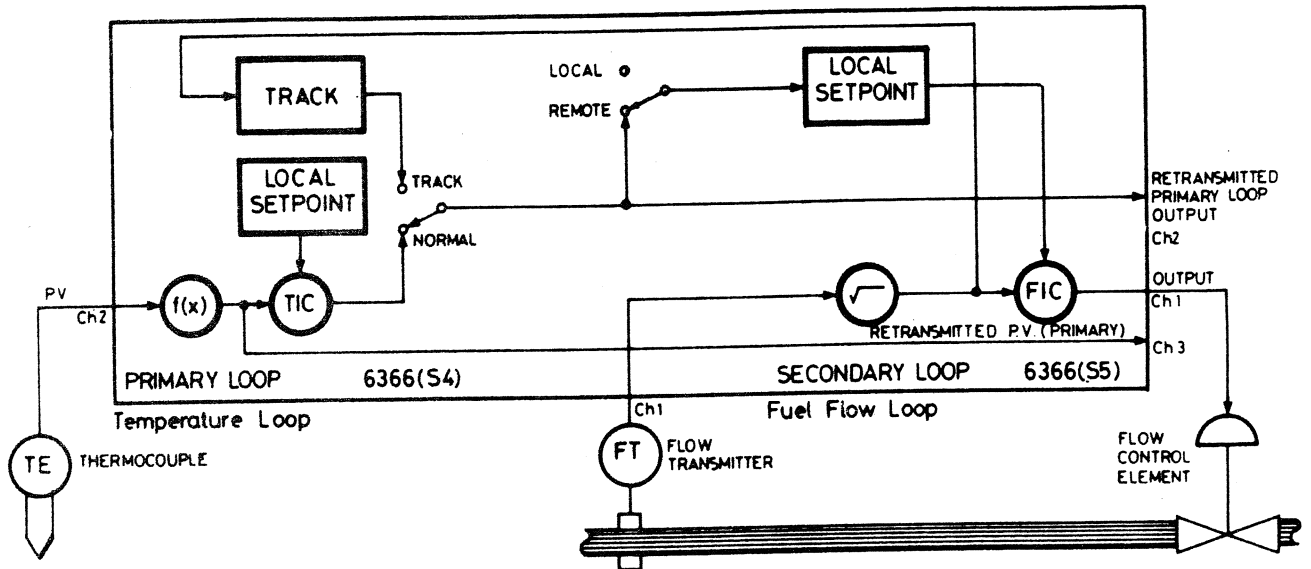
Programmable Advanced Controller

6366

Applications Library

Number 005

CASCADE PAIR CONTROLLER S4/S5



Cascade Pair Controller

The example shows a process temperature being controlled through a secondary fuel flow loop using a single 6366 Programmable Advanced Controller.

The Process Variable is used in the primary control loop to

provide a tracking facility which allows completely procedureless and bumpless transfer between modes.

This application provides similar features to those described in S0 but using a single instrument instead of 2.

Applications

Single Loop Integrity
Combustion Control
Boiler Control
Furnace Control
Gas Pressure Control

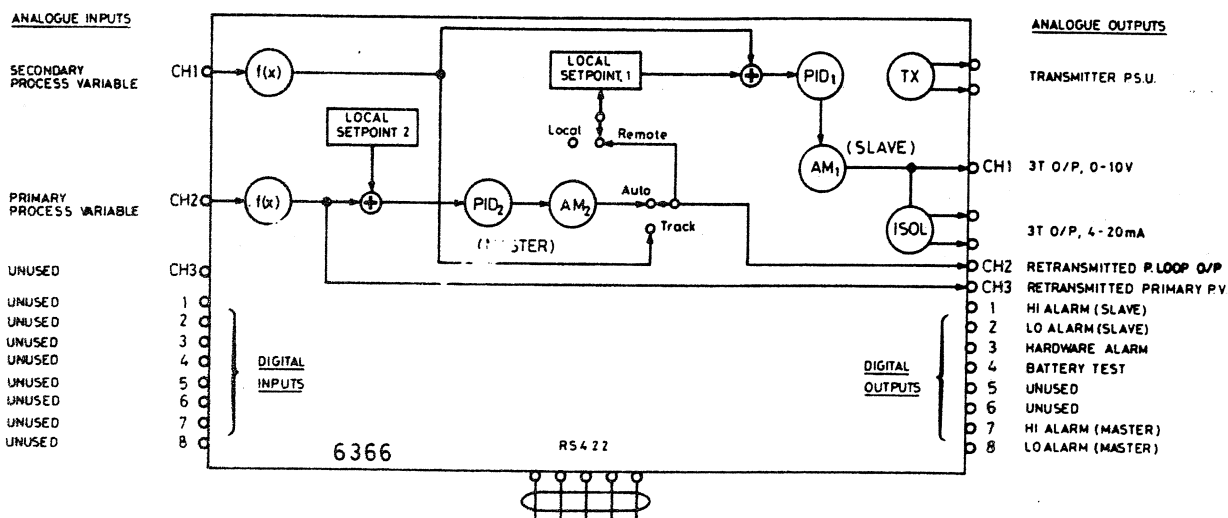
Glass Furnace/Forehearth
Reheat Furnaces
Blast Furnaces
Chemical Reaction Vessels
Cement Drying

Further Information

Further data may be found in the following Manuals:

6366 Technical Manual
6366 Programming Manual
6366 Applications Manual

Applications Program



Program Listing

```

S4      (Slave PID control program name for HHT L1 parameter)
S.ENB   (Update the Slave REMOTE status)
MS2 AO %GET (Get the Master loop control output)
SP1 %REMOTE (and set into the Remote Setpoint register 'SR')
PV1     (Get Channel 1 Analogue input for the 'PV')
PID1    (Calculate and set the 3T control output)
SETOP1
;

S5      (Master PID Control program name for HHT L2 parameter)
M.ENB   (Update the Master TRACK status)
SP1 PV %GET (Get slave PV)
MS2 OT %SET (Set masters output track register)
PV2     (Get channel 2 analogue input)
PID2    (Calculate and set the 3T control output)
MS2 MSCONT (Transfer to MS2.OP if loop is in Auto)

```

Summary of Configuration Parameters

Block	Block	Block	Relv	Block	Parameter Number															
Description	Minic	Type	Block	No	B	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
General Purpose	GP	0	1	0	ST	II	L1	L2	BG	SW	PB									
Analogue Input	AI	1	1	1	ST	HR	LR	AI	AV											
			2	2	ST	HR	LR	AI	AV											
Analogue O/P	AO	2	1	4	ST	HR	LR	HL	LL	AO										
Setpoint	SP	5	1	7	ST	HR	LR	HL	LL	PV	SP	ER	SL	SR	SB	RL	HA	LA	HD	LD
			2	8	ST	HR	LR	HL	LL	PV	SP	ER	SL	SR	SB	RL	HA	LA	HD	LD
PID Control	3T	7	1	11	ST	XP	TI	TD	FF	FB	OP	TS								
			2	12	ST	XP	TI	TD	FF	FB	OP	TS								
Manual Output Station	MS	8	1	13	ST	HV	LV	HL	LL	AO	OP	OT								
			2	14	ST	HV	LV	HL	LL	AO	OP	OT								
Display & Control	DC	9	1	15	ST	IB	2B	3B	DD	ES	SM									
			2	16	ST	IB	2B	3B	DD	ES	SM									

Background Programs

B6 Power up in last mode with last output

O/C PV (CH1 only) or sum-check error places relevant loop in to Forced Manual.

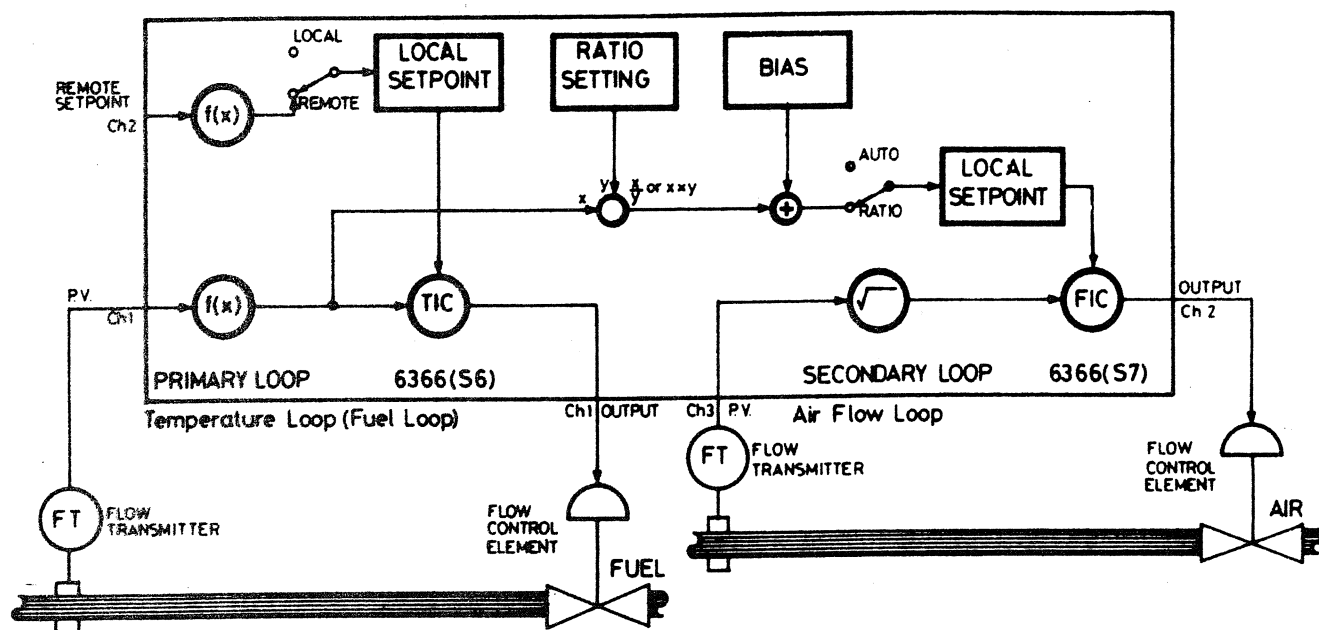
Programmable Advanced Controller

6366

Applications Library

Number 006

RATIO PAIR CONTROLLER S6/S7



Ratio Pair Controller

The fuel-air ratio control system illustrated demonstrates the full potential of the 6366 dual loop capability. The fuel flow control loop can be cascaded from an external temperature loop which in turn

provides a Ratio process variable for the secondary air flow loop.

The Ratio control loop provides a local (Auto) setpoint, a Ratio setpoint plus a Ratio Bias set via the configuration terminal.

Applications

Single Loop Integrity
Combustion Control
Boiler Control
Furnace Control
Gas Pressure Control

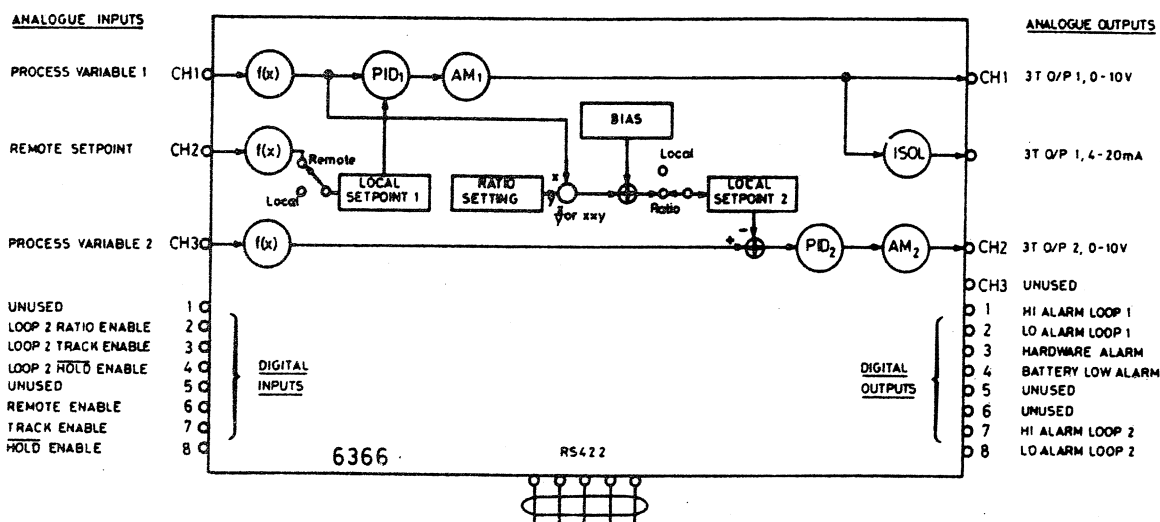
Glass Furnace/Forehearth
Reheat Furnaces
Blast Furnaces
Chemical Reaction Vessels
Cement Drying

Further Information

Further data may be found in the following Manuals:

6366 Technical Manual
6366 Programming Manual
6366 Applications Manual

Applications Program



Program Listing

```

S6      (Loop 1 of Ratio pair-Program name for L1 parameter)
REMOTE1 (Set up remote setpoint register)
PV1     (Stack process variable)
PID1    (Stack PID output)
SETOP1  (Store PID output)
;

```

```

S7      (Loop 2 of Ratio pair-program name for L2 parameter)
PV1 SP2 RATIO (Calculate Loop 2 setpoint using input 1)
PV3      (Stack PV from input 3)
PID2     (Stack PID output)
MS2 MSCONT (Store PID output)

```

Summary of Configuration Parameters

Block	Block	Block	RefV	Block	Parameter Number															
Description	Min	Type	Block	No	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
General Purpose	GP	0	1	0	ST	II	L1	L2	BG	SW	PB									
Analogue Input	AI	1	1	1	ST	HR	LR	AI	AV											
			2	2	ST	HR	LR	AI	AV											
			3	3	ST	HR	LR	AI	AV											
Setpoint	SP	5	1	7	ST	HR	LR	HL	LL	PV	SP	ER	SL	SR	SB	RL	HA	LA	HD	LD
			2	8	ST	HR	LR	HL	LL	PV	SP	ER	SL	SR	SB	RL	HA	LA	HD	LD
Ratio	RB	6																		
PID Control	3T	7	1	11	ST	XP	TI	TD	FF	FB	OP	TS								
			2	12	ST	XP	TI	TD	FF	FB	OP	TS								
Manual Output Station	MS	8	1	13	ST	HV	LV	HL	LL	AO	OP	OT								
			2	14	ST	HV	LV	HL	LL	AO	OP	OT								
Display & Control	DC	9	1	15	ST	IB	2B	3B	DD	ES	SM									
			2	16	ST	IB	2B	3B	DD	ES	SM									

Background Programs

```

B7  Power up in previous mode, O/C PV1 Forced Manual after 3 secs.
     Clears Ratio Enable loop 2.
     O/C PV2 undetected.
     Sumcheck Error Forced Manual in loop 1 and loop 2.

```

Section G.1 LIST OF 6366 APPLICATION WORDS

```

:
PV3    (Form Process variable 3)
      AI3 AV GET      (Get scaled channel 3 input)
;
:
PV2    (Form Process variable 2)
      AI2 AV GET      (Get scaled channel 2 input)
;
:
PV1    (Form Process variable 1)
      AI1 AV GET      (Get scaled channel 1 input)
;
:
PV1.OC?    (Stack input 1 open circuit flags)
      AI1 ST GET
      #0006 AND
;
:
FLASH2 (Flash left bargraph if any alarms on SP block 2)
      DC2 1B GET      (Get current display data)
      #FFFE AND      (Clear flasher bit)
      SP2 ST GET      (Get alarm status on this block)
      #00F0 AND
      IF      (IF any alarms on this block THEN)
        #0001 OR      (Set flasher bit)
      ENDIF
      DC2 1B SET      (Set display register)
;
:
FLASH1 (Flash left bargraph if any alarms on SP block 1)
      DC1 1B GET      (Get current display data)
      #FFFE AND      (Clear flasher bit)
      SP1 ST GET      (Get alarm status on this block)
      #00F0 AND
      IF      (IF any alarms on this block THEN)
        #0001 OR      (Set flasher bit)
      ENDIF
      DC1 1B SET      (Set display register)
;
:
ALARM2 (Use Digital Outputs 7 & 8 for SP block 2 alarms)
      SP2 ST GET      (Get alarms from status)
      DUP      (Save a copy)
      #00A0 AND      (Separate high alarm bits)
      NOT      (Negative logic for alarms)
      DO1 7 SETDIG      (Modify high alarm digital output bit 7)
      #0050 AND      (Separate low alarm bits)
      NOT      (Negative logic for alarms)
      DO1 8 SETDIG      (Modify low alarm digital output bit 8)
;

```

```

: ALARM1      (Use Digital Outputs 1 & 2 for SP block 1 alarms)
  SP1 ST GET   (Get alarms from status)
  DUP         (Save a copy)
  #00A0 AND    (Separate high alarm bits)
  NOT         (Negative logic for alarms)
  DO1 1 SETDIG (Modify high alarm digital output bit 1)
  #0050 AND    (Separate low alarm bits)
  NOT         (Negative logic for alarms)
  DO1 2 SETDIG (Modify low alarm digital output bit 2)
;
;
CLRXMSK      (Clear the XOR mask)
  #0000 DI1 XM SET
;
;
DOMASK1
  #003F DO1 WM SET      (Assign DO1=Loop 1 High Alarm)
    ( DO2= " Low " )
    ( DO3=Hardware " )
    ( DO4=Low battery " )
    ( DO5=NOT.Rem/Ratio Auto)
    ( DO6=NOT.[Hold OR Man])
;
;
DOMASK2      (Set a Digital Output Mask)
  #00CF DO1 WM SET      (Assign DO1=Loop 1 High Alarm)
    ( DO2= " Low " )
    ( DO3=Hardware " )
    ( DO4=Low battery " )
    ( DO7=Loop 2 High " )
    ( DO8= " " Low " )
;
;
TRACK1 (Set track value)
  AI3 AI %GET   (Get raw analogue input)
  MS1 OT %SET   (Set to track register in MS output block)
;
;
TRIM1 (Form SP trim)
  PV3 (Get trim value from input 3)
  SP1 SB SET (Set SP bias register)
;
;
REMOTE1 (Form Remote setpoint)
  PV2 (Get scaled channel 2 input)
  SP1 REMOTE (Store in RS register and reset ratio bit)
;
;
RATRIM1 (Form ratio setting trim)
  PV3 (Get trim value from input 3)
  RB1 RT SET (Set RB ratio trim register)
;
;

```

```

RATIO1 (Form Ratio setpoint)
  PV2      (Get scaled analogue value from input 2)
  SP1 RATIO (Form ratio setpoint, store in RS register
            and set ratio bit)

;
: SETES2      (Set Loop 2 Enable status)
  DC2 ES SET
;
: SETES1 (Set Loop 1 Enable status)
  DC1 ES SET
;
: SETMAN1      (Set Loop 1 into manual)
  DC1 ST GET      (Stack current operating status)
  #0008 AND        (Do not alter sumcheck bit)
  #2000 OR         (Include manual status bit)
  DC1 ST SET       (Set loop 1 into manual)
;
: SET1MAN      (Alternate technique to set loop 1 to manual)
  BEGIN          (Ensures output can be changed)
    #0081 DC1 ES SET (Select manual, no hold, no track)
    DC1 ST GET      (Stack current operating status)
    #F800 AND        (Separate operating mode bits)
    #2000 =          (Check for manual mode)
  UNTIL          (LOOP until loop in manual)
;
: MAN.LO (Set loop to manual and low output limit)
  DC1 ST GET      (IF in AUTO mode THEN)
  #0040 AND
  IF
    SETMAN1      (Set loop into manual)
    0 MS1 OP SET (Set to low output limit)
  ENDIF (ENDIF)
;
: S.REM? (Return the Slave REMOTE status)
  DC1 ST GET      (Separate the Slave Remote status flag)
  #0010 AND       (On return #0000=Remote, #0010=NOT.Remote)
;
: M.HM? (Return the Master HOLD/MANUAL status)
  DC2 ST GET      (Separate the Master Hold/Manual flag)
  #0020 AND       (On return #0000=Hold/Manual, #0020=NOT.Hold/Manual)
;
: S.ENB (Update slave REMOTE Enable)
  M.HM?          (Get Master Hold/Manual status)
  #DF00 OR        (Include mask)
  SETES1         (Modify Slave Remote Enable)
;

```

```

M.ENB (Update Master TRACK status)
  S.REM? (Find the slave Remote status)
  IF (IF the slave is NOT in REMOTE THEN)
    #BF40 (Master should be in Track)
  ELSE (ELSE)
    #BF00 (Master is not in Track)
  ENDIF (ENDIF)
  SETES2 (Modify Master Track status)
;
: RTL2.EN (Set Ratio loop 2 enable flags)
  DI1 DS GET (Assign DI2=Ratio Enable)
  #000E AND ( DI3=Track Enable)
  ( DI4=NOT.Hold Enable)
  16 * (Shift data left 4 places)
  PV1.OC?
  IF (IF Open circuit on PV1 THEN)
    #00C0 AND (Clear Ratio Enable)
  ENDIF (ENDIF)
  #1F00 OR (Mask other data)
  SETES2 (Set Loop 2 enable flags)
;
:
ENABLE1 (Set Loop 1 enable flags)
  DI1 DS GET (Get digital inputs)
  #00E0 AND (Separate NOT.Hold, Track and Rem/Ratio enable)
  #1F00 OR (Include mask in high byte)
  SETES1 (Set Loop 1 enable flags)
;
:
COM.SC? (Stack common sumcheck error flag)
  GP1 ST GET (Get general purpose status)
  #0100 AND (Separate common data base sumcheck error)
;
:
HWCHECK (Check the hardware status, update the hardware
         hardware alarm output and forced manual status)
  PV1.OC? #0002 AND (Stack Channel 1 open circuit for 3 secs flag)
  COM.SC? (Stack common sumcheck flag)
  OR
  DUP NOT (Form flag for hardware alarm output)
  DO1 3 SETDIG (Set/clear hardware alarm output)
  IF (IF open circuit OR sumcheck error THEN)
    #F708 (Stack value to set forced manual in DC1.ES)
  ELSE (ELSE)
    #F700 (Stack value to clear forced manual in DC1.ES)
  ENDIF (ENDIF)
  SETES1 (Set/clear forced manual flag on loop 1)
;
:

```



```

HWLOCHK (Check the hardware status. This word is similar to
        HWCHECK, but sets MS1.OP to low limit if any faults)
PV1.OC? #0002 AND      (Stack Channel 1 open circuit for 3 secs flag)
COM.SC? (Stack common sumcheck flag)
OR
DUP NOT (Form flag for hardware alarm output)
DO1 3 SETDIG (Set/clear hardware alarm output)
IF      (IF open circuit OR sumcheck error THEN)
  MAN.LO      (IF Auto THEN set loop 1 to Man & Low limit ENDIF)
  #F708      (Stack value to set forced manual in DC1.ES)
ELSE      (ELSE)
  #F700      (Stack value to clear forced manual in DC1.ES)
ENDIF      (ENDIF)
SETES1      (Set/clear forced manual flag on loop 1)
;
PE
: HWCHKL2      (Monitor the common sumcheck bit and update
               the forced manual status on loop 2)
  COM.SC? (Stack common sumcheck flag)
  IF      (IF Sumcheck error THEN)
    #F708      (Stack value to set forced manual in DC2.ES)
  ELSE      (ELSE)
    #F700      (Stack value to clear forced manual in DC2.ES)
  ENDIF      (ENDIF)
  SETES2      (Set/clear forced manual flag on loop 2)
;
:
: BATTEST      (Check battery)
  GP1 ST GET      (Get battery low bit)
  #0800 AND
  NOT      (Inverse logic on digital output)
  DO1 4 SETDIG      (Set battery status in digital outputs)
;
:
: DIGOP1      (Set digital outputs with loop status)
  DC1 ST GET      (Get status)
  #0030 AND      (Separate NOT.Hold+Manual and NOT.Rem/Ratio)
  #CF00 OR      (Include mask in high byte)
  DO1 DS SET      (Set digital outputs)
;
:
: PID2      (Loop 2 PID calculation)
               (Enter with PV on stack--Return with OP on stack)
  MS2 AO %GET      (Find current output)
  3T2 FB SET      (Feed value back to PID block 2 for desaturation)
  3T2 PID (Calculate PID output leave OP value on stack)
;
:
: PID1      (Loop 1 PID calculation)
               (Enter with PV on stack--Return with OP on stack)
  MS1 AO %GET      (Find current output)
  3T1 FB SET      (Feed value back to PID 1 block for desaturation)
  3T1 PID (Calculate PID output leave OP value on stack)
;
:

```

```
ER1OUT (Retransmit SP1.ER on Analogue Output Block 1)
  SP1 ER %GET
  8 *      (Amplify the signal)
  50 +     (Add in 50% offset)
  AO1 AO %SET      (Re transmit the Error signal)
;
:
SP1OUT (Retransmit SP1.SP on Analogue Output Block 1)
  SP1 SP %GET
  AO1 AO %SET      (Retransmit the Setpoint value)
;
:
PV2OUT (Retransmit PV2 on Analogue Output Block 1)
  SP2 PV %GET
  AO1 AO %SET      (Retransmit the PV)
;
PE
: PV1OUT      (Retransmit PV1 on channel 2 output)
  #3FCO SETES2      (Set into track)
  SP1 PV %GET
  MS2 OT %SET      (Force channel 2 output to track PV)
;
:
SETOP1 (Set Channel 1 control output)
  PV1.OC? (Get open circuit flags)
  IF      (IF Open circuit flag set THEN)
    DROP  (Discard output due to dubious PV value)
  ELSE    (ELSE)
    MS1 MSCONT      (Store loop 1 required output)
  ENDIF    (ENDIF)
;
:
FLOWTOT      (Totalise value on top of stack and transmit a
              pulse on Dig O/P 7 whenever FT is incremented)
  0 DO1 7 SETDIG (Reset Dig O/P 7 to zero)
  TB1 TOTAL      (Totalise entry data)
  DO1 7 SETDIG   (Use return flag to modify Dig O/P 7)
;
```

Section G.2 LIST OF TIME-SCHEDULED PROGRAMS

```

: S0      (Standard controller configuration)
      TRACK1 (Set up track register)
      TRIM1  (Set up trim register)
      REMOTE1 (Set up remote setpoint register)
      PV1    (Stack process variable)
      PID1   (Stack PID output)
      SETOP1 (Store PID output)
;
:
: S1      (Ratio controller configuration)
      TRACK1 (Set up track register)
      RATRIM1 (Set up ratio setting trim register)
      RATIO1 (Calculate setpoint from ratio PV)
      PV1    (Stack process variable)
      PID1   (Stack PID output)
      SETOP1 (Store PID output)
;
:
: S2      (Simple PID loop 1)
      PV1
      PID1
      SETOP1
;
:
: S3      (Simple PID loop 2)
      PV2
      PID2
      MS2 MSCONT
;
:
: S4      (Slave PID control program name for HHT L1 parameter)
      S.ENB      (Update the Slave REMOTE status)
      MS2 AO %GET (Get the Master loop control output)
      SP1 %REMOTE (and set into the Remote Setpoint register 'SR')
      PV1        (Get Channel 1 Analogue input for the 'PV')
      PID1       (Calculate and set the 3T control output)
      SETOP1
;

```

```
:
S5      (Master PID control program name for HHT L2 parameter)
M.ENB   (Update the Master TRACK status)
SP1 PV %GET (Get slave PV)
MS2 OT %SET (Set masters output track register)
PV2 (Get channel 2 analogue input)
PID2    (Calculate and set the 3T control output)
        MS2 MSCONT      (Transfer to MS2.OP if loop is in Auto)
;
:
S6      (Loop 1 of Ratio pair-Program name for L1 parameter)
REMOTE1 (Set up remote setpoint register)
PV1     (Stack process variable)
PID1    (Stack PID output)
SETOP1  (Store PID output)
;
:
S7      (Loop 2 of Ratio pair-Program name for L2 parameter)
PV1 SP2 RATIO      (Calculate Loop 2 setpoint using input 1)
PV3      (Stack PV from input 3)
PID2     (Stack PID output)
MS2 MSCONT      (Store PID output)
;
```

Section G.3 LIST OF BACKGROUND PROGRAMS

```

: B0      (Background program)
BEGIN     (Infinite loop)
  ENABLE1 (Enable loop 1 states)
  HWCHECK (Check hardware status)
  BATTEST
  DIGOP1  (Set status digital outputs)
  ALARM1  (Set alarm digital outputs)
  FLASH1  (Flash left bar if any alarms)
  DOMASK1 (Set WM mask)
  CLRXMSK (Clear XM mask)
  PVIOUT  (Retransmit PV on Manual Station 2)
  SPIOUT  (Retransmit SP on Analogue Output 1)
REPEAT    (Back to start of loop)
;
;
B1      (Program to initialise in Man with Low Output)
SET1MAN (Set loop 1 into Manual)
0 MS1 OP SET (Set to Low Output)
B0      (Share B0 background program)
;
;
B2      (Background program)
BEGIN     (Infinite loop)
  ENABLE1 (Enable loop 1 states)
  HWLOCHK (Check hardware status & select LO on errors)
  BATTEST
  DIGOP1  (Set status digital outputs)
  ALARM1  (Set alarm digital outputs)
  FLASH1  (Flash left bar if any alarms)
  DOMASK1 (Set WM mask)
  CLRXMSK (Clear XM mask)
  PVIOUT  (Retransmit PV on Manual Station 2)
  SPIOUT  (Retransmit SP on Analogue Output 1)
REPEAT    (Back to start of loop)
;
;
B3      (Program to initialise in Man with Low Output)
SET1MAN (Set loop 1 into Manual)
0 MS1 OP SET (Set to Low Output)
B2      (Share B2 background program)
;
;
B5      (Simple Background Program to enable both loops)
BEGIN     (Infinite loop)
  #1F80 SETES1 (Remove Track Hold & Remote Enable on Loop 1)
  #1F80 SETES2 ( " " " " " " " " 2)
REPEAT    (Back to start of loop)
;

```

```

: B6      (Background program)
      BEGIN      (BEGIN infinite loop)
      #3F80 SETES1      (Clear Hold & Track Enables on slave loop 1)
      #5F80 SETES2      (Clear Hold & Remote Enables on Master loop 2)
      DOMASK2      (Update the Digital Output Mask)
      HWCHECK      (Monitor Hardware, update Dig O/P 3 & loop 1 status)
      HWCHKL2      ( " " " loop 2 status)
      BATTEST      (Monitor battery and update Dig O/P 4)
      FLASH1      (Flash Loop 1 PV bar if any alarms on SP block 1)
      FLASH2      ( " " 2 " " " " " " " 2)
      ALARM1      (Modify Dig O/P 1 & 2 if any alarms on SP block 1)
      ALARM2      ( " " " 7 & 8 " " " " " 2)
      PV2OUT      (Retransmit Master PV on A01)
      REPEAT      (LOOP back to start)
;
;
B7      (Background program for Ratio Pair)
      BEGIN      (Infinite loop)
      ENABLE1      (Enable loop 1 states)
      RTL2.EN      (Enable loop 2 states)
      HWCHECK      (Monitor Hardware, update Dig O/P 3 & loop 1 status)
      HWCHKL2      ( " " " loop 2 status)
      BATTEST
      ALARM1      (Set alarm digital outputs)
      ALARM2
      FLASH1      (Flash left bar if any alarms)
      FLASH2
      DOMASK2      (Set WM mask)
      CLRXMSK      (Clear XM mask)
      REPEAT      (Back to start of loop)
;

```