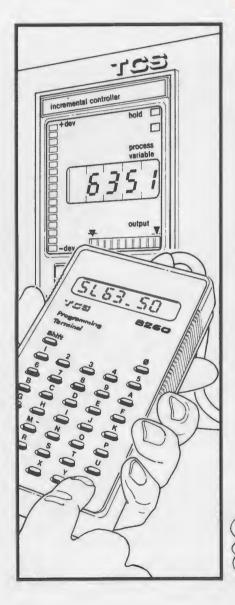
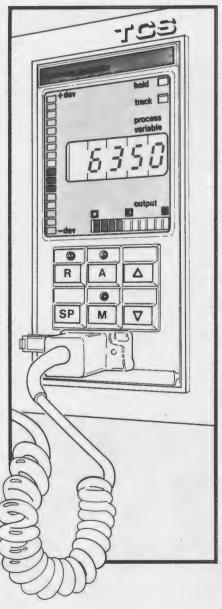




system 6000







Reference Section

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Scope

This section has been specifically written for the semiexperienced user who is relatively familiar with the general operation of TCS Controllers.

Since this section is primarily intended for reference purposes, the text has been carefully structured to allow easy access to all technical information.

The section combines the description of five Single Loop Controllers, and forms a complete synopsis which supports all issues of each Controller released to date.

In October 1987, the first edition of this reference section was amended to cover the release of the 'A' Series Controllers. These new controllers are functionally identical to their first generation counterparts, but use an improved single motherboard hardware design.

The Reference Section now supports the following Instruments:

6350 / 6350A Process Controller

6351 / 6351A Incremental Controller

6355 / 6355A Auto-tuning Controller

6360 / 6360A Process Controller

6365 / 6365A Auto-tuning Controller

Issue 2/A OCTOBER 1987

Turnbull Control Systems Limited (TCS) are continuously seeking ways to improve products, and therefore reserve the right to modify the design of a product at any time without prior notice.

All information supplied in this document is intended for guidance only, and whilst every effort is made to ensure that all information is accurate, TCS cannot accept any responsibility for any error contained in the information hereinafter.

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Contents

Index	(ii)
General Points	1
Operator Interface	3
Controlling Modes	9
Parameter Database	11
Parameter Descriptions	15
Switch Functions	39
Fault Finding Hints	45
Pin Connections	53
Software Revisions	55
Schematic Diagrams	60

	1		}
A	- Indication22	G	Local Se
	(6350, 6355)3		— Ac
A Pushbutton Mask18	(6351)5	Gain21	(6350
A Pushbutton Test30	(6360, 6365)7	Group Address 12, 23, 24	(6351
Absolute Alarms20	- History 56, 57	Group Address Select41	(6360
Actuation Input Selection34	— Limits 20, 30		- Inc
AD Parameter34	- Sumcheck Failure Actions 30		(6350
Analogue Input Voltage Range. 44	Samonoux I and to Addons	H	(6351
t the of the training of the	Cross Ranging19		(6360
ASCII Protocol:	Cross nanging	HA Parameter20	— Lir
- Operation12		na rarameter20	
	D	11- 1 Al OF 00 00 45	— Tra
- Selection41	D	Hardware Alarm:25, 28, 30, 45	
Selected? 23, 24		- Indication	Local Te
	Data Corruption9, 30	(6350, 6355)4	Lower C
Automatic Mode:	47, 50, 55	(6351)6	LR Para
— Operation 9	Dead Band21	(6360, 6365)	LS Para
— Select 28, 31	Decimal Point Positioning16	- Selection43	
- Selection/Indication45	Decimal Points Flashing		
(6350, 6355)4	(Front Panel)45	Hardware Developments54	M
(6351)		HD Parameter20	
(6360, 6365)8	Derivative Time Constant 21, 22	HO Parameter20	M Pushl
,,,	Derivative Action Disable 21, 34		M Pushl
	Deviation Alarms 20, 45	Hold Mode:	Manual
В	Deviation Alamis 20, 45	- Indication	Ivianuai
	D. Jaking Brown I		
Page Barry Countril 04 FG F3	Deviation Bargraph	(6350, 6355)	Manual
Bang-Bang Control 21, 56, 57	(6350, 6355)	(6351)5	— Op
	(6351)5	(6360, 6365)7	— Se
Battery Voltage Alarm: 25, 50		— Operation 9	
- Indication	Digital Input States26	- Selected? 25, 28, 31	(6350
(6350, 6355)4	Digital Output States26		(6351
(6351)6		HR Parameter19	(6360
(6360, 6365)	Digital Readout Indication	HS Parameter19	
4	(6350, 6355)	Hunting21	MD Para
Baud Rate (RS 422):	(6351)5		
- Indication 23, 24	(6360, 6365)		Measure
- Selection 40, 41	(0000)		- Co
	Direct 3-Term Control Action 42	7	
Baud Rate (Local Terminal) 41, 51	DP Parameter21	IC Parameter18	— De
	DS Parameter26	ID Parameter35	- Inc
Binary Protocol:	DT Parameter35	Identification Test 35, 36	
- Format Number13	Di Farameter		(6350
		IF Parameter20	(6351
— History 55, 56	-	II Parameter 16, 55	(6360
— Operation12	E	IM Parameter34	- Int
- Parameter Tables 13, 14		Image Register13	
— Selection 41	EL Parameter20	Input Filter20	Minimu
— Selected? 23, 24	Enquiry Polling13	Instrument Identity16	(6351
	ER Parameter22	Integral Action Disable 21, 34	MN Para
Bumpless Transfer40	Error Limit20	Integral Desatuation 20, 55	MP Para
Burden Resistor 44, 52	Error Term41	Integral Term Balance23, 24,	Multi-pa
	Error Value22	40, 55	
_		Integral Time Constant 21, 22	
C		Inverse Function (Signal	N
	F	Processing)18	
CF Parameter			
	Failure Actions 43, 50	Inverse Ratio Setpoint:	0
Channel 3 (Output):	Fault Finding Hints Index 45, 46	— Configured? 23, 24	
- Selected Function 23, 24, 44			OD Para
— Selected Fullction 23, 24, 44	Filter20	— Operation10	
		— Select42	On-Off (
Communications Fault	Forced Manual Mode: 30, 31, 45		
— RS 422 41,46,	- Indication	Inverse 3-Term Action42	OP Para
51, 52	(6350, 6355)4		Open-Ci
- Front Panel 46, 51	(6351)6	_	
	(6360, 6365)	J	
Computer Enable Input 25, 52	- Operation		Operation
Confidence Factor36			— Fu
Confidence Factor	Forced Automatic Mode:32	K	— Pri
Threshold 34, 38	- Indication		- Se
Control Element Travel Time20	(6350, 6355)4		(6350
Control Problems46	(6351)6	L	(6351
Control Froblems46			4
Controller Output	(6360, 6365)	1 A Parameter	(6360
Controller Output:	— Operation 9	LA Parameter20	- St
- Action Select42	Comment Number	Lamp Test30	
- Action Selected? 23, 24	Format Number13	LD Parameter20	Output
— Adjustment9, 22	Front Panel Tests30		(6350
(6350, 6355)4		Linearisation:	(6351
(6351)6		- Selection18	(6360
(6360, 6365)			
		LO Parameter20	
			7.

Local Setpoint: — Adjustment
(6350, 6355) 4
(6351)6
(6360, 6365)8
— Indication21
(6350, 6355)
(6360, 6365)7
- Limits19
- Tracking Selected? 23, 24
Local Terminal Operation12 Lower Output Channel25
LR Parameter19
LS Parameter19
M
IVI
M Pushbutton Mask18
M Pushbutton Test30
Manual Backup50
Manual Mode: — Operation9
- Operation 9 - Selection/Indication 28, 31,
42, 45
42, 45 (6350, 6355)4
(6351)6
(6360, 6365)8
MD Parameter 28, 30
WID Farameter 20, 30
Measured Power:
- Configuration24, 30,
42, 56, 57
Decimal Point Position 16 Indication
(6350, 6355) 3
(6351)
(6351)5
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
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(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)
(6351)

P
Parameters:
- Loading11
- Structure11
Parameter Change Flag 32, 56, 57
Parameter Corruption 9, 30, 47, 50, 55
PG Parameter
PID Update Period 20, 22
Piggy-back Format34
Pin Connections
Pin 10 44, 52
Pin 11
Pin 13 44, 52
Pin 14
Pin 1620
Pin 1720 Pin 1843
Pin 2248 Pin 2348
Pin 24 41, 51
Pin 25
Pin 27 41, 51
Pin 28
42, 49
Pin 3019, 28,
42, 47, 52
Pin 31
Plant Disturbance Faults46
Plant Disturbance Faults
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) 3
Plant Disturbance Faults
Plant Disturbance Faults
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) (6351) 5 (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: Annunciation 20, 25, 45
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) 3 (6351) (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: Annunciation 20, 25, 45 Hysteresis 20
Plant Disturbance Faults
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) 3 (6351) (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: Annunciation 20, 25, 45 Hysteresis 20 Process Variable 22, 28
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) (6351) 5 (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: Annunciation 20, 25, 45 Hysteresis 20 Process Variable 22, 28 Process Variable Open Circuit 28 Proportional Band Constant 21 Protocol (ASCII/Binary)
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) (6351) 5 (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: — Annunciation 20, 25, 45 — Hysteresis 20 Process Variable 22, 28 Process Variable Open Circuit 28 Proportional Band Constant 21 Protocol (ASCII/Binary) — General Description 12
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) (6351) 5 (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: Annunciation 20, 25, 45 Hysteresis 20 Process Variable 22, 28 Process Variable Open Circuit 28 Proportional Band Constant 21 Protocol (ASCII/Binary)
Plant Disturbance Faults
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) (6351) 5 (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: Annunciation 20, 25, 45 Hysteresis 20 Process Variable 22, 28 Proportional Band Constant 21 Protocol (ASCII/Binary) 2 General Description 12 Selection 41 Selected? 23, 24 PRT Linearisation 18, 19 Pushbutton Faults 45
Plant Disturbance Faults
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) (6351) 5 (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: 40 Annunciation 20, 25, 45 Hysteresis 20 Process Variable 22, 28 Process Variable Open Circuit 28 Proportional Band Constant 21 Protocol (ASCII/Binary) General Description 12 Selection 41 Selected? 23, 24 PRT Linearisation 18, 19 Pushbutton Faults 45 Pushbutton Masking 4, 6, 8, 18, 25, 55
Plant Disturbance Faults 46 Polling 13 Power Failure 43, 50 Power Failure Flag 32, 50, 56, 57 Power On Indicator (6350, 6355) 3 (6351) (6360, 6365) 7 Predicted Process Variable 44 Process Alarms: 44 Process Alarms: 20, 25, 45 Hysteresis 20 Process Variable 22, 28 Process Variable Open Circuit 28 Proportional Band Constant 21 Protocol (ASCII/Binary) 6 Selection 41 Selection 41 Selected? 23, 24 PRT Linearisation 18, 19 Pushbutton Faults 45 Pushbutton Masking 4, 6, 8, 18, 25, 55 Pushbutton Tests 30 PV Bargraph 7, 45
Plant Disturbance Faults

Q
R
R Pushbutton Mask 18 R Pushbutton Test 30 Raise Output Channel 25 Ranging Inputs 19 Ratio Bias 10, 21
Ratio Configuration: 10 — Indication 23, 24 — Selection 42
Ratio Mode: — Enabled
(6350, 6355) 4 (6351) 6 (6360, 6365) 8 — Operation
Ratio Setpoint: — Adjustment10, 21,
56, 57 — Bias
Ratio Setpoint Trim: — Decimal Point Position16 — Linearisation
RB Parameter
Remote Mode: - Enabled
28, 31 — Operation
Remote Setpoint: — Decimal Point Position 16 — Enable 9 — Linearisation 18 — Ranging 19
Resultant Setpoint9, 22 Retransmitted Deviation23, 24, 44
Retransmitted Setpoint23, 24, 44
Reverse Controller Output Action

RS 422:
- ASCII Protocol12
 Binary Protocol 12, 13
- Computer Enable 25
— Faults46
- Format Number13
- Group Ident. Address.12, 23
— Operation12
— Operation12
- Protocol Selected 23, 24
- Unit Ident. Address 12, 25
RS Parameter21
RT Parameter37
S
Sampling Rate 20, 37
Setpoint Adjustment9, 10
(6350, 6355)
(6351)
(6360, 6365)
Setpoint Limits
21, 55, 56
Setpoint Perturbation35
Setpoint Tracking44
Setpoint Trim:
- Decimal Point Position16
- Linearisation18
- Ranging19
- Resultant Setpoint22
01.0
SL Parameter 21, 35
SL Parameter 21, 35 SP Parameter
SP Parameter
SP Parameter
SP Parameter
SP Parameter 22 SP Pushbutton Test 30 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9.30
SP Parameter 22 SP Pushbutton Test 30 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30 47, 50, 55 SW Parameter 23
SP Parameter 22 SP Pushbutton Test 30 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30
SP Parameter 22 SP Pushbutton Test 30 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24
SP Parameter 22 SP Pushbutton Test 30 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41
SP Parameter 22 SP Pushbutton Test 30 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 93 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55 — SB1/SW2 55
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank Settings 40, 41 — SB1/SW1 55 — SB1/SW2 51 — SB1/SW3 51
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 93 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55 — SB1/SW2 55
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 30 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 36 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51 — SB1/SW5 51 — SB1/SW6 51 — SB1/SW7 51
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 36 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51 — SB1/SW5 51 — SB1/SW5 51 — SB1/SW6 51
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 93 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51 — SB1/SW5 51 — SB1/SW6 51 — SB1/SW7 51 — SB1/SW8 51
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 36 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 55 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51 — SB1/SW6 51 — SB1/SW7 51 — SB1/SW8 51 SWitchbank 2: 42, 43, 44
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 36 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 51 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51 — SB1/SW5 51 — SB1/SW6 51 — SB1/SW7 51 — SB1/SW8 51 Switchbank 2: 42, 43, 44 — SB2/SW1 10
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 36 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 51 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51 — SB1/SW5 51 — SB1/SW7 51 — SB1/SW8 51 Switchbank 2: 42, 43, 44 — SB2/SW1 10 15, 16, 15
SP Parameter 22 SP Pushbutton Test 36 Special Linearisation 18 Square Root Function 18 Sumcheck Failure 9, 36 47, 50, 55 SW Parameter 23 Switchbank Settings 23, 24 Switchbank 1: 40, 41 — SB1/SW1 51 — SB1/SW2 51 — SB1/SW3 51 — SB1/SW4 51 — SB1/SW5 51 — SB1/SW6 51 — SB1/SW7 51 — SB1/SW8 51 Switchbank 2: 42, 43, 44 — SB2/SW1 10
SP Parameter

•
T? Parameter 36 TD Parameter 21, 36 Thermocouple Linearisation 18, 19 TI Parameter 21, 36 Time Constant Units 23, 24, 43 TM Parameter 21, 30 TP Parameter 20, 30
Track Mode: — Ranging
(6350, 6355)
Transmitter Interfacing 46 Faults 46 TS Parameter 22 TT Parameter 20, 30, 36 Tuning Status 34 Tuning Constants 21, 36, 37, 44
U
U? Parameter 37 Unit Address 12, 25 User Logic Bits 25 User Specified Linearisation 18
V
W
Watchdog Alarm43, 45, 50
X
XP Parameter 21, 36
Υ
Z
1H 1L
3-Term Action: - Select
%C Parameter 34, 38, 49 %X Parameter 34, 38, 49

Essential Information

 There are four designs of racking system used by TCS, and a different numbering system is used on the terminals of each type of rack or sleeve.

The different numbering systems used are as follows:-

- Module Pin Numbers*
- 7900 Powered Sleeve Terminal Numbers
- 7600 Bin System Terminal Numbers
- 7950 Universal Packaging System Terminal Numbers
- 7000 Fully Engineered Racking System (Terminal number prefixed by CA or CB)

*The Module Pin Numbering system is used throughout Training Documentation.

When referring to any system drawings, always check to see which numbering system is used.

- 2. Do not connect an Intelligent Instrument directly to mains voltages.
- 3. The analogue output signal transmitted from Channel 1 (Pin 32) is normally connected to an Actuator or another "Slave" controller in a Cascade Control System.

This output signal is termed the "Controller Output" signal in all Training Literature. The reader is warned that this signal is sometimes called the "3-Term Output" signal in other documentation produced by TCS.

4. All output signals from Intelligent Instruments will drop to 0 Volts when the power supply is interrupted or when the instrument is removed from the slot. If necessary, there are two possible ways to provide backup facilities to support the Controller Output signal in this situation:-

- (i) Automatic backup facilities can be provided in a number of different ways using equipment powered from an alternative source.
- (ii) An alternative manual backup facility can also be provided in the form of a portable battery powered Manual Backup Unit (TCS Product: 8550), which is plugged into a special socket located underneath the controller on the front panel. This unit can support a control signal for approximately 12 hours.
- 5. All parameter data stored in the Random Access Memory will remain secure while the instrument is un-powered for a period in excess of five years. The integrity of the data stored in all parameters is checked when the instrument is powered up, and then continuously checked during normal operation.

Therefore, data corruption is unlikely to occur without being detected by the instrument's diagnostic routines.

- 6. A Supervisory Computer cannot communicate with an Intelligent Instrument when a Local Terminal is plugged into the front panel.
- Thermocouples and other "low level" input signals cannot be directly connected to an Intelligent Instrument.
- 8. Remember that the Controller Output signal level cannot change in Hold Mode.

To activate the Controller Output signal, the digital input signal to Pin 31 must be taken High. This is normally achieved by connecting a link between Pin 9 (Watchdog alarm output — a source of 15 Volts) and Pin 31

- 9. TCS have not adopted the standard convention for defining the Error Term or the 3-Term Control Action.
- 10. Parameter EL (Error Limit) can affect the 3-Term control characteristic.

) Positive Deviation Bargraph -

(3) Negative Deviation Bargraph

These bargraphs represent the Deviation or Error between the Process Variable and Resultant Setpoint. The respective bargraph will continuously flash to indicate a Process Alarm condition, which occurs when a Deviation Alarm Limit is exceeded.

The corresponding display segments illuminate at the following Deviation or Error values:-

0.5% 1.5% 2.5% 3.5% 4.5% 5.5% 6.5% 7.5%

6 Power On Indicator -

The green LED in the centre of the two deviation bargraphs is used as a power-on indicator.

In the event of a Watchdog Alarm, this indicator will remain On while all other displays are blanked. This makes it possible to distinguish between this fault condition and a power supply failure.

7 Output Bargraph

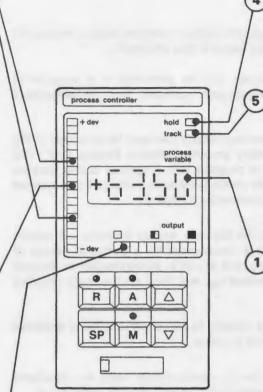
In primary display format (when no pushbuttons are pressed on the front panel) the Output Bargraph will normally display the value of the Controller Output in percentage units. However, if the Measured Power facility is used, the Output Bargraph will indicate the value of the Measured Power signal.



When either the M, A or R pushbuttons are pressed, the Output Bargraph will always indicate the Controller Output value.

The corresponding display segments illuminate at the following Controller Output or Measured Power values:-

5% 15% 25% 35% 45% 55% 65% 75% 85% 95%



4 Hold Mode Indicator

Hold Mode overrides all other operating modes and holds the value of the Controller Output. Hold Mode is selected by a digital input signal.

Track Mode Indicator

Track Mode overrides all other operating modes except Hold Mode. In Track Mode, the Controller Output is controlled from the analogue input to channel 3. Track Mode is selected by a digital input signal.

Digital Readout

In primary display format (when no pushbuttons are pressed), the Digital Readout displays the value of the Process Variable in engineering units.



If the SP pushbutton is depressed, the Digital Readout displays the value of the Local Setpoint (in engineering units), unless the controller is operating in Ratio Mode, whereupon the Ratio Setpoint will be displayed instead.



When either the M, A or R pushbuttons are depressed the Digital Readout will normally display the value of the Controller Output in percentage units. However, if the Measured Power facility is used, the Digital Readout will indicate the value of the Measured Power signal in engineering units.

An additional facility on 6365 Autotuning Controller allows the Digital Readout to flash continuously when the controller requires re-tuning.

Battery Failure

The Random Access Memory is supported by a Long Life Battery during power interruptions. The condition of this battery is tested about once every 10 minutes during normal operation.

If this test fails, the unused decimal points on the Digital Readout will flash on and off continuously.

Manual Mode Select



Manual Mode allows the user to directly control the Controller Output signal from the front panel. The Pushbutton Masking facility can inhibit the use of this pushbutton to select Manual Mode.

A continuously flashing LED indicates that the controller has been "forced" into Manual Mode due to a Hardware Alarm condition.

Automatic Mode Select



In this mode, the Controller Output signal operates under automatic 3-Term control. The Pushbutton Masking facility can inhibit the use of this pushbutton to select Automatic Mode.

Setpoint Adjustment



The Local Setpoint can be adjusted in Automatic Mode by pressing the SP and either the or pushbuttons together.

The Local Setpoint can also be adjusted in Manual Track and Hold modes if Setpoint Tracking is not enabled. (Setpoint Tracking is selected using an internal switch).

Both the Local and Resultant Setpoints are subject to user defined limits.

Remote / Ratio Mode Select



In Remote Mode, the Local Setpoint is controlled from an analogue input signal on channel 2, and the Controller Output signal is under automatic 3-Term control.

The controller can only operate in Remote Mode if the digital input to the Remote Setpoint Enable is High, otherwise the controller is "forced" into Automatic Mode instead.

Ratio Mode is substituted for Remote Mode in Ratio Configuration, and uses the same method of selection and indication on the front panel.

In Ratio Mode, the Controller Output signal is automatically controlled to maintain the Ratio between the Process (or "Manipulated") Variable on channel 1 and the Secondary (or "Wild") Variable on channel 2.

Pushbutton Masking Facility

It is possible to inhibit the use of the M, A and B pushbuttons to select the respective operating modes from the front panel.

Controller Output Adjustment



Direct manipulation of the Controller Output value is only possible in Manual Mode. Adjustment is achieved by pressing the M and either the or volume or volume.

Positive Deviation Bargraph

Negative Deviation Bargraph -These bargraphs represent the Deviation or Error between the Process Variable and Resultant Setpoint. The

respective bargraph will continuously flash to indicate a Process Alarm condition, which occurs when a Deviation Alarm Limit is exceeded.

The corresponding display segments illuminate at the following Deviation or Error values:-

> 0.5% 1.5% 2.5% 3.5% 4.5% 5.5% 6.5% 7.5%

Power On Indicator -

The green LED in the centre of the two deviation bargraphs is used as a power-on indicator.

In the event of a Watchdog Alarm, this indicator will remain On while all other displays are blanked. This makes it possible to distinguish between this fault condition and a power supply failure.

Output Bargraph

In primary display format (when no pushbuttons are pressed on the front panel) the Output Bargraph will normally display the status of the "Raise" and "Lower" Controller Output signals. Only the two extreme left and right segments on the bargraph are used for this purpose.

However, if the Measured Power facility is used, the Output Bargraph will indicate the value of the Measured Power signal.

The corresponding display segments illuminate at the following Measured Power values:-

> 5% 15% 25% 35% 45% 55% 65% 75% 85% 95%



When either the M, A or R pushbuttons are pressed, the Output Bargraph will always indicate the current status of the digital Controller Output signals.

Hold Mode Indicator

Hold Mode overrides all other operating modes and holds the value of the Controller Output. Hold Mode selected by a digital input signal.

Digital Readout

In primary display format (when no pushbuttons are pressed), the Digital Readout displays the value of the Process Variable in engineering units.



If the SP pushbutton is depressed, the Digital Readout displays the value of the Local Setpoint (in engineering units), unless the controller is operating in Ratio Mode, whereupon the Ratio Setpoint will be displayed instead.



When either the M, A or R push-buttons are depressed the Digital Readout will be blanked, unless the Measured Power facility is used, whereupon the Digital Readout will indicate the value of the Measured Power signal in engineering units.

Battery Failure

incremental controller

+ dev

hold

process

-

0

M

SP

Δ

V

The Random Access Memory is supported by a Long Life Battery during power interruptions. The condition of this battery is tested about once every 10 minutes during normal

If this test fails, the unused decimal points on the Digital Readout will flash on and off continuously.

Manual Mode Select



Manual Mode allows the user to directly control the Controller Output signal from the front panel. The Pushbutton Masking facility can inhibit the use of this pushbutton to select Manual Mode.

A continuously flashing LED indicates that the controller has been "forced" into Manual Mode due to a Hardware Alarm condition.

Automatic Mode Select



In this mode, the Controller Output signal operates under automatic 3-Term control. The Pushbutton Masking facility can inhibit the use of this pushbutton to select Automatic Mode.

Setpoint Adjustment



The Local Setpoint can be adjusted in Automatic Mode by pressing the SP and either the or pushbuttons together.

The Local Setpoint can also be adjusted in Manual Track and Hold modes if Setpoint Tracking is not enabled. (Setpoint Tracking is selected using an internal switch).

Both the Local and Resultant Setpoints are subject to user defined limits.

Remote / Ratio Mode Select



In Remote Mode, the Local Setpoint is controlled from an analogue input signal on channel 2, and the Controller Output signal is under automatic 3-Term control.

The controller can only operate in Remote Mode if the digital input to the Remote Setpoint Enable is High, otherwise the controller is "forced" into Automatic Mode instead.

Ratio Mode is substituted for Remote Mode in Ratio Configuration, and uses the same method of selection and indication on the front panel.

In Ratio Mode, the Controller Output signal is automatically controlled to maintain the Ratio between the Process (or "Manipulated") Variable on channel 1 and the Secondary (or "Wild") Variable on channel 2.

Pushbutton Masking Facility

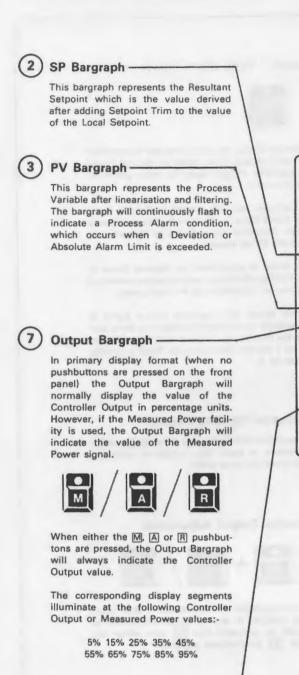
It is possible to inhibit the use of the M, A and R pushbuttons to select the respective operating modes from the front panel.

Controller Output Adjustment



Direct manipulation of the Controller Output value is only possible in Manual Mode. Adjustment is achieved by pressing the M and either the ▲ or ▼ pushbuttons together.

REFERENCE



Battery Failure

process controller

- 80 -

60

20

PV %SP

R

SP

ALL

M

hold

track

process

3.80

output

The Random Access Memory is supported by a Long Life Battery during power interruptions. The condition of this battery is tested about once every 10 minutes during normal operation.

If this test fails, the unused decimal points on the Digital Readout will flash on and off continuously.

Hold Mode Indicator

Hold Mode overrides all other operating modes and holds the value of the Controller Output. Hold Mode is selected by a digital input signal.

Track Mode Indicator

Track Mode overrides all other operating modes except Hold Mode. In Track Mode, the Controller Output is controlled from the analogue input to channel 3. Track Mode is selected by a digital input signal.

Digital Readout

In primary display format (when no pushbuttons are pressed), the Digital Readout displays the value of the Process Variable in engineering units.



If the SP pushbutton is depressed, the digital readout displays the value of the Local Setpoint (in engineering units), unless the controller is operating in Ratio Mode, whereupon the Ratio Setpoint will be displayed instead.



When either the M, A or R pushbuttons are depressed the Digital Readout will normally display the value of the Controller Output in percentage units. However, if the Measured Power facility is used, the Digital Readout will indicate the value of the Measured Power signal in engineering units.

An additional facility on 6365 Autotuning Controller allows the Digital Readout to flash continuously when the controller requires re-tuning.

Power On Indicators

power supply failure.

cators.

The bottom two bars on the PV and SP

Bargraphs are used as Power On indi-

In the event of a Watchdog Alarm, these indicators will remain On while

all other displays are blanked. This

makes it possible to distinguish

between this fault condition and a

Manual Mode Select



Manual Mode allows the user to directly control the Controller Output signal from the front panel. The Pushbutton Masking facility can inhibit the use of this pushbutton to select Manual Mode.

A continuously flashing LED indicates that the controller has been "forced" into Manual Mode due to a Hardware Alarm condition.

Automatic Mode Select



In this mode, the Controller Output signal operates under automatic 3-Term control. The Pushbutton Masking facility can inhibit the use of this pushbutton to select Automatic Mode.

Setpoint Adjustment



The Local Setpoint can be adjusted in Automatic Mode by pressing the SP and either the or pushbuttons together.

The Local Setpoint can also be adjusted in Manual Track and Hold modes if Setpoint Tracking is not enabled. (Setpoint Tracking is selected using an internal switch).

Both the Local and Resultant Setpoints are subject to user defined limits.

Remote / Ratio Mode Select



In Remote Mode, the Local Setpoint is controlled from an analogue input signal on channel 2, and the Controller Output signal is under automatic 3-Term control.

The controller can only operate in Remote Mode if the digital input to the Remote Setpoint Enable is High, otherwise the controller is "forced" into Automatic Mode instead.

Ratio Mode is substituted for Remote Mode in Ratio Configuration, and uses the same method of selection and indication on the front panel.

In Ratio Mode, the Controller Output signal is automatically controlled to maintain the Ratio between the Process (or "Manipulated") Variable on channel 1 and the Secondary (or "Wild") Variable on channel 2.

Pushbutton Masking Facility

It is possible to inhibit the use of the M, A and R pushbuttons to select the respective operating modes from the front panel.

Controller Output Adjustment



Direct manipulation of the Controller Output value is only possible in Manual Mode. Adjustment is achieved by pressing the M and either the or pushbuttons together.

Process Alarm Settings



It is possible to view the settings of the Process Alarms on the PV and SP Bargraphs.

When the pushbutton is pressed the High Absolute Alarm limit is displayed on the PV Bargraph, and the High Deviation Alarm limit is displayed on the SP Bargraph.

The two Low Process Alarm settings are displayed on each bargraph when the v pushbutton is pressed.

Hold Mode

Hold Mode overrides all other modes of operation and causes the Controller Output Signal to be frozen.

This operating mode is selected when the digital input on Pin 31 is Low. The Controller Output is activated when the digital input to pin 31 is High (linking Pin 31 with Pin 9 is a convenient method of disabling Hold Mode).

Track Mode

Track Mode is selected when the digital input on Pin 30 goes High and this mode will override the normal operating modes (Manual, Automatic and Remote).

In this operating mode, the PID control function is bypassed and the Controller Output Signal is controlled directly from the analogue input signal on Channel 3.

The operation of the Local Setpoint is dependant on the position of switch SB 2 / SW 6. If this switch is On, the Local Setpoint will follow the Process Variable. However, when the switch is Off, the Local Setpoint remains constant, and may be adjusted by pressing the SP and either the or pushbuttons, or alternatively, by writing to Parameter SL.

Track Mode is not available on the 6351 Incremental Controller.

Manual Mode

In Manual Mode, the user has direct control of the Controller Output signal. This signal can be adjusted from the front panel by pressing the M and either the or very pushbuttons, or alternatively, by writing to Parameter OP.

The operation of the Local Setpoint in this mode is dependant on the position of Switch SB 2 / SW 6.

If this switch is On, the Local Setpoint will follow the Process Variable Signal. However, when this switch is Off, the Local Setpoint remains constant, and may be adjusted from the front panel by pressing the SP and either the ▲ or ▼ pushbuttons, or alternatively, by writing to Parameter SL.

Forced Manual Mode

There are circumstances where a controller cannot operate in Automatic or Remote / Ratio Modes, and therefore the controller is "forced" into Manual Mode.

These circumstances occur when the controller detects either an open-circuit Process Variable input signal, or data corruption within a parameter.

The Controller Output signal can be adjusted from the front panel, but the user cannot select Automatic or Remote / Ratio Modes until the fault is eliminated. If corrupted data has been detected within a parameter, the user defined Controller Output Limits will be cleared to ensure that the user has full control over the Controller Output signal in the "forced" Manual Mode.

Automatic Mode

In Automatic Mode, the Controller Output signal is controlled in relation to the Process Variable and the Resultant Setpoint. The response to any changes in demand in this mode is dependant on the characteristics of the P I D control function.

These characteristics have to be set up or "Tuned" to the particular Process in order to achieve the optimum control.

The value of the Local Setpoint can be adjusted from the front panel by pressing the SP and either the a or pushbuttons, or alternatively by writing to Parameter SL.

Remote Mode

This operating mode is similar to Automatic Mode, except that the Local Setpoint follows an analogue input signal on Channel 2. Remote Mode is a conditional mode of operation which is dependant on the status of the digital input on Pin 29.

Therefore, a Controller can only operate in Remote Mode when the digital input on Pin 29 is High. This input is called the "Remote Setpoint Enable".

If the digital input on Pin 29 is Low the controller will default into Automatic Mode when Remote Mode is selected. The indicator on the A pushbutton will flash continuously to indicate this condition.

The controller will enter (or re-enter) Remote Mode as soon as the Remote Setpoint is enabled (Pin 29 = High).

The value of the Local Setpoint can be monitored using parameter SL, but the user is prevented from making any direct adjustments to this value in Remote Mode. However, the Local Setpoint can be adjusted if the controller defaults into "forced" Automatic Mode.

Local Setpoint Trim

This facility allows an offset to be introduced to the Controlled Variable in a process control loop. The amount of offset can be varied using an analogue input signal on Channel 3.

The Setpoint Trim facility acts after the Local Setpoint register and the sum of these two values is termed the Resultant Setpoint. Both the Local and Resultant Setpoints are subject to user defined limits specified in parameters HS and LS.

Track Mode cannot be used in conjunction with the Setpoint Trim facility, and the Measured Power facility is also mutually exclusive with Setpoint Trim.

The Local Setpoint Trim will operate in all controlling modes, but this facility is not available in Ratio Configuration.

Ratio Mode

Ratio Mode is substituted for Remote Mode and uses the same method for selection and indication on the front panel.

Ratio Configuration is selected when switch SB 2 / SW 1 is On. This effectively modifies the function of the analogue input to channel 2 by introducing an additional multiplication or division function, another setpoint, and alters the function of Setpoint Trim.

In Ratio Configuration, Channel 2 is used to measure the Secondary or Wild Variable, which controls the value of the Local Setpoint when the controller is operating in Ratio Mode.

The operation of the controller in Automatic and Manual Modes is identical in Ratio Configuration, except that there is no facility to trim the Local Setpoint.

The operator interface from the front panel is altered slightly in Ratio Mode. The Ratio Setpoint is displayed on the Digital Readout when the SP pushbutton is depressed in Ratio Mode. The value of the Ratio Setpoint can be adjusted by pressing the SP and either the or pushbuttons, or alternatively, by writing to Parameter RS.

The action of the Ratio Setpoint on the Secondary Variable is defined by the position of Switch SB 2 / SW 3 and the effect of this switch is shown below:-

Normal Ratio: SL = SV / RRS Inverse Ratio: SL = SV x RRS

Where:

SL = Local Setpoint (Resultant Setpoint)

SV = Secondary Variable

RRS = Resultant Ratio Setpoint

RRS = RS + RST

Where:

RS = Ratio Setpoint

RST = Ratio Setpoint Trim (see below)

Ratio Setpoint Trim

This facility allows external adjustment of the Ratio Setpoint from an analogue input signal on channel 3. The Setpoint Trim is added to the Ratio Setpoint to produce a Resultant Ratio Setpoint, and both of these variables are subject to user-defined Ratio Setpoint Limits specified in parameters HR and LR.

Channel 3 cannot be used for the Measured Power Facility. Track Mode also utilises the input to channel 3, and therefore cannot be implemented in conjunction with Setpoint Trim.

Ratio Bias

Parameter RB allows a constant to be added to, or subtracted from, the derived Local Setpoint in Ratio Mode only. The data entered into parameter RB is measured in the same engineering units as Channel 1.

Operating Mode Priorities

It is often very useful to consider the priority level allocated to each operating mode, in order to understand the behaviour of the controller in certain situations.

Hold Mode can be considered as having the highest priority level in controllers. This mode will override Track operating mode which is allocated the second level of priority, except on the 6351 Incremental Controller where Track Mode is not available.

Selection of Manual, Automatic and Remote / Ratio modes is mutual and exclusive. These controlling modes share the third level of priority.

For example, consider the situation where a controller is operating in Manual Mode, and then Track Mode is selected. Since Track Mode has higher priority, the controller will transfer from Manual to Track Mode. When Track mode is de-selected, the controller will then "drop back" into Manual Mode.

Now consider the case where a controller is operating in Track Mode when a user has selected Automatic Mode. The controller will remain in Track Mode since this mode has the higher priority. However, when Track mode is de-selected, the controller will then transfer into Automatic Mode.

Loading Parameters

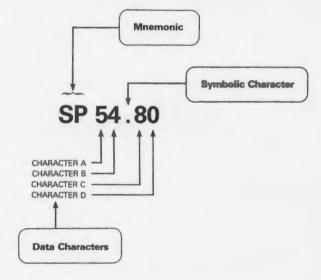
There are two way of loading parameters into Intellegent Instruments.

- From a Local Terminal which is plugged into the socket provided on the front panel of each controller.
- From a Computer System linked to an instrument through the RS 422 serial communications link provided on the backplane connector of each controller.

Both of these methods use the same communication port on each instrument, even though the protocol format and signal standards are different. Therefore, when a local terminal, is plugged into the front panel of an instrument, this will override and disable communications on the RS 422 serial port at the back of each instrument.

Parameter Structure

The first two characters in all parameters are called Mnemonics. These characters are a type of label which identifies the function of each parameter. All configuration parameters use four character data fields, and these characters are referenced "A B C and D" in text.



There are two types of data field used in parameters:

- Numerical Characters used for input ranges, limits, analogue variables etc.
- Hexadecimal Characters used for inspection and configuration of digital registers. Parameters containing Hexadecimal Data are called Status Words.

Each data character can operate in two modes. Some characters are used to display information. These characters have Read Only status and are often described as being "Masked". Alternatively, data characters can have Read / Write status. These characters are used to configure or change information stored in the controller.

In addition to the mnemonic and data characters, an extra Symbolic Character conveys further information about the data field. The symbolic character indicates the position of the decimal point in parameters with numerical data. When the parameter has a negative value, the symbolic character will appear as a minus sign in the position of the decimal point. A > symbol is used to indicate that the data field is assigned to hexadecimal numbers in a Status Word.

Local Terminal Operation

Inspecting Parameters

A Local Terminal can be used to inspect any parameter in the database of a controller with the exception of parameter MN

This key initialises or re-initialises the terminal to display the command prompt (?? CMD).

A parameter can be called by entering the respective two character mnemonic. The data associated with the parameter will be returned on the terminal display.

- W This key is used to scroll down to the next parameter in the list.
- The data viewed on the display of the terminal is not automatically updated by the instrument. This key can be used to update the data displayed on the terminal.

Loading New Data

Parameters with Read / Write status can be changed from a Local Terminal. The flashing digit on the display indicates the cursor position. All data characters must be overwritten before the data can be loaded.

- This key backspaces the cursor to correct mistakes.
 Backspacing beyond character A will recall the original data.
- This key is used to load positive data.
- M This key is used to load negative data.

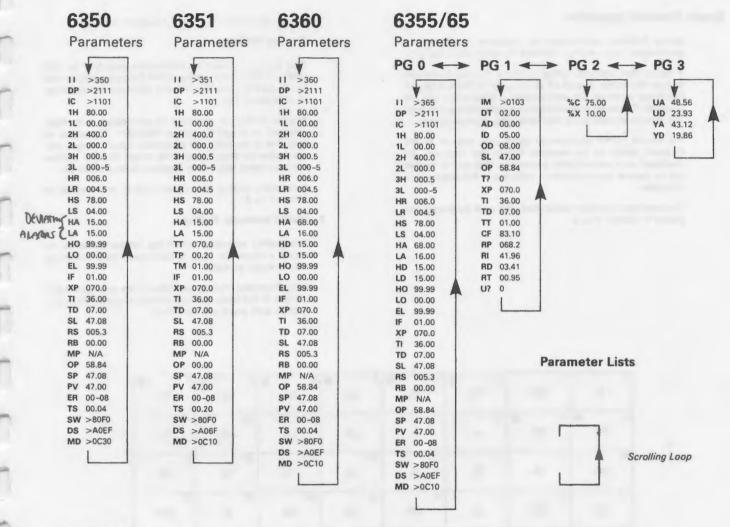
The terminal display will be cleared when the data is loaded. The data field is checked and if necessary, adjusted to comply with the appropriate range definition and limits. The data which is finally entered into the database is returned on the terminal display.

Transferring between Parameter Lists

(6355 6365 Only)

The Auto-tuning controllers have four separate parameter lists. The main list of parameters has been designed to be similar to other controllers. The other parameters are associated with the operation of the Auto-tuning facilities. These have been separated into three lists to allow for convenient and secure operation.

The PG parameter is used to transfer between lists. This parameter is only available by direct access after re-initialising the terminal by pressing the Z Key.



RS 422 Data Communications Link

Operation

This facility allows all Intelligent Instruments to be linked to a central processor, in order to implement distributed control strategies.

The link operates on the same principle as a data bus. Up to 127 unit addresses can be specified on each instrument, and these are divided up into 8 Groups of 16 Units. A Single Loop Process Controller is classified as a single Unit.

The Data transfer is controlled by the central processor and takes place in half-duplex mode with error detection. The transmission rate can be selected from a range of settings between 110 to 9600 Baud.

Two different types of communication protocol are supported by all Intelligent Instruments:

- ASCII Protocol is a standard implementation of a highintegrity serial data transfer system. The parameter data is transferred as standard ASCII characters, which is less efficient in terms of transfer rates, but far easier to use. This protocol is generally used on small computer systems where a relatively slow system response time can be tolerated.
- 2. Binary Protocol is designed for use on Supervisory Control Systems, where data transfer requires to be highly efficient. Binary Protocol compresses the structure and format of the parameters to gain a 4 and 1 increase in transmission speed. This protocol also supports Multi-Parameter and Enquiry Polling facilities.

ASCII Protocol Operation

In ASCII protocol, the character strings have a similiar structure to the parameters viewed on a local terminal connected to the front panel port.

Parameters are transmitted in a character string comprising of a 2 character mnemonic, 4 data characters and a symbolic character.

Four address characters are also transmitted along with various other characters used for the purpose of error checking and to control the data transfer sequence.

In addition, ASCII protocol allows a computer system to scroll round a parameter list. This facility can be used for data acquisition, and operates in a similar manner to the scroll facility on a local terminal.

Binary Protocol Operation

Binary Protocol compresses the structure and format of parameters to gain a 4 to 1 increase in transmission speed.

A typical data character string in Binary Protocol is reduced to four characters instead of seven used in ASCII protocol. Parameter numbers are used instead of Mnemonics and the Symbolic Character is replaced by a binary Format Number. The instrument address is identified using a single character.

The format of the compressed serial data used in Binary Protocol needs to be changed before the data can be displayed as a conventional parameter. This task is carried out by special communications software in the Supervisory Computer.

The parameter numbers associated with each mnemonic are shown in Tables 1 to 4.

Binary protocol offers two other important facilities:

1. Enquiry Polling.

This facility provides a considerable reduction in data traffic on the communications link. Only new data is sent to the central processor by each instrument in response to an Enquiry Poll.

Enquiry Polling is restricted to parameters with flags allocated in a special "Image Register". The status of each flag is set when the parameter value changes, and reset after an enquiry poll. The Image Register defines the parameters returned in response to an enquiry poll.

Parameters subject to enquiry polling are marked in Tables 1 to 4.

2. Multi-Parameter Polling

This polling sequence allows the central processor to access a sequential block of parameters by transmitting only a single message.

Multi-Parameter Polling can start from any parameter number in the table, and the number of parameters sent back in each block can be varied.

0		1			2		3	•	4		5		6		9 7	7	
	11		DP			1H		1L		HA		LA		MN			SP
8	PV	9	OP	•	10		11	-	12	HS	13	LS	14	НО	1	15	LO
16	HR	17	LR		18	SL	19	EL	20	XP	21	TI	22	TD	2	23	2H
24	2L	25	зн		26	3L	27	MP	28	RS	29	RB	30	IC	3	31	SW
32	DS	33	IF		34	TS	 35	ER	36	MD	37	_	38	_	3	39	_

HA 078059

Table 1 • Parameter subject to Enquiry Polling

6350 Process Controller

0			1			2			3			4		•	5		•	6		7	
	11			DP			1H			1L			HD			LD			MN	-	SP
8	PV	•	9	OP	•	10	НА	•	11	LA	•	12	HS		13	LS		14	но	15	LO
16	HR		17	LR		18	SL		19	EL		20	XP		21	TI		22	TD	23	2H
24	2L		25	ЗН		26	3L	-	27	MP		28	RS		29	RB		30	IC	31	sw
32	DS		33	IF		34	TS		35	ER		36	MD		37	_		38	_	39	_

Table 2 Parameter subject to Enquiry Polling

6360 Process Controller

0		1		2		• 3		• 4		5		9 6	•	7	6
	11		DP		1H		1L		HA		LA		MN		SP
8	•	9		10		11	-	12		13		14	4	15	
	PV		OP		-				HS		LS				_
16		17		18		19		20		21		2	2	23	
	HR		LR		SL		-		XP		TI		TD		2H
24		25		26		27		28		29		3	0	31	
	2H		3H		3L		MP		RS		RB		IC		SW
32		33		34		35		36		37		31	В	39	
	DS		1F		TS		ER		MD		TT		TP		TM

HA 078060

Table 3 • Parameter subject to Enquiry Polling

6351 Incremental Controller

0		1	2	3	4	5	6	7
	ll	DP	1H	1L	HD	LD	MN	SP
8	PV	9 OP	10 HA	11 • LA	HS	13 LS	14 HO	15 LO
16	HR	17 LR	18 SL	19 EL	20 XP	21 TI	22 TD	23 2H
24	2L	25 3H	26 3L	27 MP	28 RS	29 RB	30 IC	31 SW
32	DS	33 IF	34 TS	35 ER	36 MD	37 PG	38 TT	39 DT
40	AD	41 OD	42 T?	43 IM	44 RP	45 RI	46 RD	47 RT
48	U?	49 CF	50 ID	51 —	52 —	53	54 —	55 —
56	_	57 UA	58 UD	59 YA	60 YD	61	62 —	63 —
64	_	65	66	67	68	69	70 —	71 —
72	_	73 —	74	75	76 %C	77 %X	78 —	79 —

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Table 4 • Parameter subject to Enquiry Polling

6355/6365 Auto-Tuning Controller

Parameter Descriptions

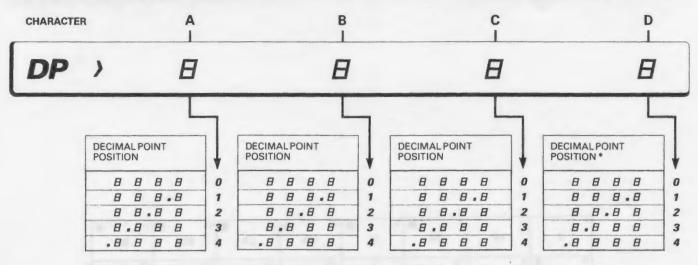


TABLE 1

Mnemonics (See Note 1)	Parameter Function	Parameter Di Character Assignment
1H	Process Variable High Range	A
1L	Process Variable Low Range	A
2H	Connedent Veriable High Bonne	В
2L	Secondary Variable High Range Secondary Variable Low Range	В
3H	Channel 3 High Range (See Table below)	A/C/D
3L	Channel 3 Low Range (See Table below)	A/C/D
HR	Ratio Setpoint High Limit	D*
LR	Ratio Setpoint Low Limit	D*
HS	Local and Resultant Setpoint High Limit	A
LS	Local and Resultant Setpoint Low Limit	A
на	High Absolute Alarm Limit	A
LA	Low Absolute Alarm Limit	A
HD	High Deviation Alarm Limit	A
LD	Low Deviation Alarm Limit	A
(HA)	High Deviation Alarm Limit (see Note 2)	A
(LA)	Low Deviation Alarm Limit (see Note 2)	A
SL	Local Setpoint	A
RS		
HS	Ratio Setpoint	D*
RB	Ratio Bias	A
MP	Measured Power Value	
SP	Resultant Setpoint	A
PV	Process Variable (Measured Value)	A
ER	Error Value (PV - SP)	A

*Character D has Read-only Status.

Parameter Mnemonics which are offset right in this column do not appear on the parameter list displayed on a Local Terminal in certain configurations.

Note 2

These parameter Mnemonics are used on 6351 and early issues of 6350

Note 3On 6351, 6355, 6365 and early issues of 6350 and 6360 Controllers, the Measured Power Facility was selected using Switch SB 2 / SW 2 instead of Parameter MD

TABLE 2 3H AND 3L PARAMETER

Parameter MD > Bit 4 Status (SB 2 / SW 2 Status - See Note 3)	Parameter Function		Parameter Di Character Assignment
Bit 4 = 0 (Switch = Off)	SB2/SW1 = Off	3H = Local Setpoint Trim High Range 3L = Local Setpoint Trim Low Range	A
	SB 2/SW 1 = On	3H = Ratio Setpoint Trim High Range 3L = Ratio Setpoint Trim Low Range	D*
Bit 4 = 1 (Switch = On)	3H = Measured Power High Range 3L = Measured Power Low Range		C

Instrument Identity

This "Monitor Only" parameter can be used to identify which type of controller is communicating on the RS 422 Data Interface.

Characters A, B and C in this parameter represent the last 3 figures in the Controller's Product Code e.g. "360", and Character D indicates the issue of software used in the controller.

This parameter is not available on the early issues of 6350 controller.

DP Decimal Point Positions

The function of this parameter is to select or indicate the position of the decimal point in parameters which have data expressed in Engineering Units such as Deg C, Bars, Gallons, Litres. etc.

These parameters can be split into 4 different groups. Three of these groups can be associated with variables from each of the analogue input channels, and the fourth group is related to a variable (the Ratio Setpoint) which can be manipulated from a parameter or the front panel, but not directly from an analogue input channel.

The functions of channels 2 and 3 can be altered, and have to be defined during the configuration of the controller. Consequently the function of characters B and C vary within this parameter, which also affects the masking level on each character accordingly.

The user normally selects the required position of the decimal point in the range parameters during the initial stages of configuring the controller. Once the decimal point has been positioned, there should be no reason to change parameter DP.

The masking level on each character prevents the user from inadvertently changing the position of the decimal point in the channels which require the same range or scale.

The other parameters in the group corresponding to the function of the signal from the channel will have their decimal point positioned as appropriate to the range. This simplifies the operation of entering parameter data and reduces the chances of errors.

Character A

Channel 1 Functions

This character positions the decimal point in all parameters measured in Engineering Units whose functions are associated with Channel 1.

These parameters are indicated in Table 1 opposite.

Character B

Channel 2 Functions

Channel 2 can be used for one of two different functions depending on the configuration of the controller selected on switch SB 2 / SW 1.

If Switch SB 2 / SW 1 is Off (Normal Configuration), Channel 2 is used as the Remote Setpoint Input. In this case the ranging and units of measurement is the same as Channel 1 and therefore this character has Read-Only Status, and echoes Character A.

If Switch SB 2 / SW 1 is **On** (Ratio Configuration), Channel 2 is used as the Secondary Variable (Ratio Process Variable) Input. In this configuration Channel 2 is ranged independently to Channel 1 using parameters **2H** and **2L**, and the decimal point position in these parameters is specified using this character.

Character C

Channel 3 Functions

Channel 3 can be used for one of three different functions depending on the configuration of the controller. (Refer to table opposite).

- If parameter MD > Bit 4 = 1 or SB 2 / SW 2 = On^a (Measured Power Display Select), the input signal on Channel 3 is linked to the Output Displays on the front panel which is used to monitor the operation of a Control Element or Actuator. This input is ranged using parameters 3H and 3L and the position of the decimal point in these parameters is specified using this character.
- If parameter MD > Bit 4 = 0 or SB 2 / SW 2 = Off^a the input signal on Channel 3 is used for either Local Setpoint Trim, or Ratio Setpoint Trim.
 - (a) When Switch SB 2 / SW 1 = Off (Normal Configuration), parameters 3H and 3L range the Local Setpoint Trim which has the same scaling and units as Channel 1, therefore, the decimal point is in the same position as Channel 1 and this character echoes character A in this condition.
 - (b) However, when Switch SB 2 / SW 1 = On (Ratio Configuration), parameters 3H and 3L are used to range the Ratio Setpoint Trim which is scaled but has no units. The optimum position for the decimal point in parameters 3H and 3L is automatically calculated from the information entered into character A and B in this parameter. This character which has Read-Only status, will echo character D in this configuration.
- In Track mode, the input signal on channel 3 is used to control the level of the Controller Output signal. Track mode is selected when the digital input to Pin 30 is at High status.

Parameters 3H and 3L are not used in this configuration (they should both be set to 0000), and Measured Power display facility must be disabled (i.e. MD > Bit 4 = 0 or Switch SB 2 / SW 1 = Off°).

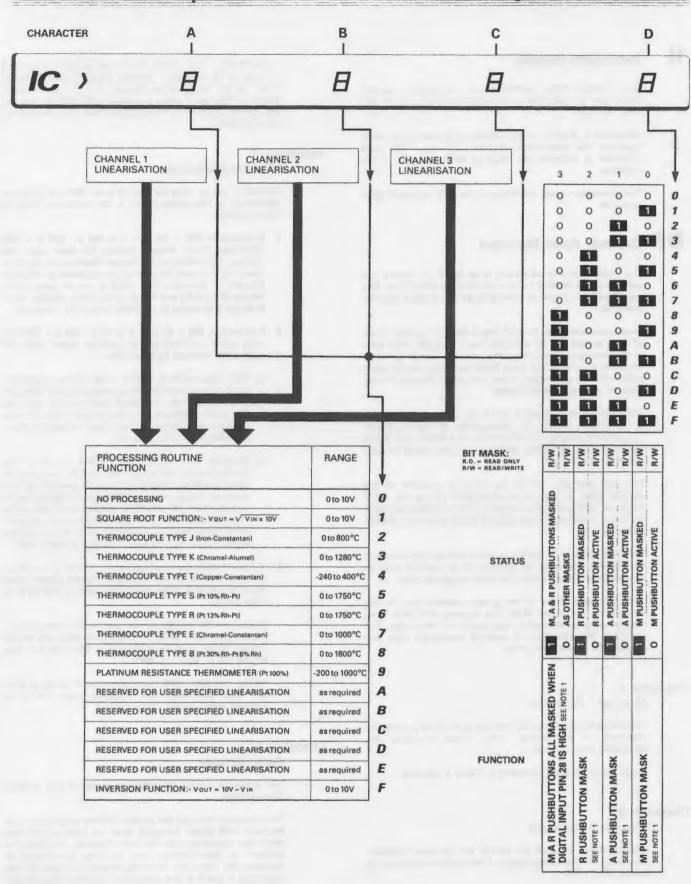
*Note: The 6351, 6355 and 6365 and early issues of 6350 and 6360 controllers, the Measured Power facility is selected using Switch SB 2 / SW 2.

Character D

Ratio Setpoint

This character is used for indication purposes only in Ratio Configuration.

The character indicates the position of the decimal point in parameter RS (Ratio Setpoint) and the other parameters which are associated with the Ratio Setpoint. The optimum position for the decimal point in these parameters is automatically calculated from the information entered into characters A and B in this parameter, and this character will display the calculated position which cannot be changed by the user.



Note 1

The Pushbutton mask only inhibits the use of the pushbutton for selecting the relative operating mode from the front panel, the other pushbutton functions remain unaffected by the mask

IC Input Linearisation Functions Pushbutton Masking

Characters A, B & C

Input Linearisation Functions

These Characters are used to select the individual processing function applied to each channel. A suite of 10 functions is available as standard, with facilities to accommodate a further 5 special processing functions which can be specified by the customer, used for linearising signals from Pyrometers, and Pressure Transmitters, etc.

The 5 special linearisation functions are stored in the Programmable Read Only Memory and these functions cannot be altered by the user.

Character D

Pushbutton Masking

This Character is derived from the status of Bits 3 to 0. The Pushbutton Masking facility allows a user to inhibit the use of pushbuttons on the front panel for changing the operating mode. Two levels of mask can be selected using this Character:

- The first level is a continuous mask which is applied permanently.
- The second level is applied according to the status of a Digital Input.

Note that these facilities do not affect the operation of the SP pushbutton which is used to alter the Local Setpoint in certain modes of operation, and remember that the user can still adjust the Controller Output Signal from the front panel if the controller is in Manual Mode, irrespective of the Mask.

Bit 3 Conditional Mask

This Bit selects the facility which prevents the user changing the controller's operating mode from the front panel when the digital input on Pin 28 is High. However, if this input is Low the Controller Operating Modes can be selected from the front panel as normal, unless the pushbuttons have been independently masked using Bits 2, 1 and 0 of this parameter.

This facility is selected by setting the status of this Bit High.

- Bit 2 Permanent Mask R pushbutton
- Bit 1 Permanent Mask A pushbutton
- Bit 0 Permanent Mask M pushbutton

These Bits allow the user to select a facility and prevents anyone changing the controller's operating mode from the front panel. The facility can be applied to each pushbutton independently and used in conjunction with Bit 3 to apply a combination of permanent and conditional masking facilities.

General Notes on Ranging Parameters

The actual values used in these ranging parameters must be compatible with the Transmitter or Input Converter associated with each input channel.

When a Thermocouple or a PRT Linearisation function is employed on an input channel, the user is reminded that the total range of these Linearisation Functions must not be exceeded. Details of these ranges are given in table opposite.

In recent issues of 6350 and 6360 controllers, a facility has been introduced to allow "Cross Ranging". This means that the High Range parameter can be set at a value which is less than the Low Range parameter.

i.e. 1H > 1L or 1H = 1L or 1H < 1L

The main application for this facility is found in Vacuum Control where the Process Variable value will rise instead of falling to the Low Range value when the channel is open circuit.

Remember that the Local Setpoint has the same range as Channel 1 (specified in parameters 1H and 1L), and adjustment of the Local Setpoint by pressing the SP and pushbuttons on the front panel, always causes the Setpoint to move towards the value specified in Parameter 1H (High Range).

The "Cross Ranging" facility is available on all three Analogue Input Channels.

The 6351, 6355, 6365 and early issues of 6350 and 6360 controllers do not support the "Cross Ranging" facility therefore in these controllers, the High Range Parameter must be greater than or equal to the Low Range Parameter.

i.e. 1H > 1L or 1H = 1L

The High Range Parameter MUST NOT be set less than the Low Range Parameter in these controllers.

1H Process Variable High and 1L Low Range

2H Second Channel High and 2L Low Range

(These parameters are only used in Ratio Configuration)

3H Third Channel High and Low Range

The function of these two parameters is dependent on the task chosen for Channel 3 during the configuration of the controller.

These functions are outlined below:-

 Measured Power Input (MD > Bit 4 = 1 or SB 2 / SW 2 = On*)

In this configuration 3H and 3L are used to range the Measured Power signal, which is derived from a transmitter placed directly on the Control Element.

Local Setpoint Trim (SB 2 / SW 1 = Off)
 or
 Ratio Setpoint Trim (SB 2 / SW 1 + On)

When MD > Bit 4 = 0 or SB2 / SW 2 = Off* (Measured Power select) the parameters 3H and 3L are used to specify the range of the Setpoint Trim.

Setpoint Bias can be achieved by setting 3H=3L at the required value, and because the range is "trapped", it is independent of the analogue signal applied to this Channel.

3. Track Mode Signal Input

Track Mode is selected by a High logic input on Pin 30, allowing control of the Controller Output signal from an analogue input on channel 3. In this configuration, 3H and 3L should be set to **0000**.

*Note: The 6351, 6355 and 6365 and early issues of 6350 and 6360 controller, the Measured Power facility is selected using switch SB 2 / SW 2.

HR Ratio Setpoint Limits

These parameters are only used in Ratio Configuration, (i.e. SB 2 / SW 1 = On) where they limit the adjustment of the Ratio Setpoint.

HS Setpoint Limits

These parameters limit the adjustment of the Local Setpoint, and the Resultant Setpoint if Local Setpoint Trim is being used. The user is warned that these Setpoint Limits are still active in Ratio Mode* where they override the Ratio Setpoint Limits (HR and LR).

* On early issues of 6350 and 6351 parameters HS and LS were inactive in Ratio Configuration.

General Note Process Alarms Annunciation

A Process Alarm condition is indicated on the front panel of the controller and causes one of two digital output channels (Pins 16 and 17) to trip to a Low logic state.

The digital output channel on Pin 16 which is associated with the High Process Alarm condition will trip when either the High Deviation or Absolute Alarm Limits are exceeded, and the same action will occur on Pin 17 if either of the Low Alarm Limits are exceeded.

HA Absolute Alarm Limits

LA

(NOT 6350/6351)

These parameters specify the high and low values at which the Process Alarms are tripped. There is 0.5% hysteresis on each limit.

HD Deviation Alarm Limits

LD

(NOT 6350/6351)

These parameters specify the high and low deviation value at which the Process Alarms trip. There is 0.5% hysteresis on each limit. (LD will only accept positive data).

HA Deviation Alarm Limits

LA

(6351 AND 6350 ONLY)

These parameters are used to specify the high and low values at which the respective Process Alarm will trip. There is 0.5% hysteresis on each limit. (LA will only accept positive date). Absolute alarm facilities are *not* provided in these controllers.

HO Controller Output Limits

LO

(NOT 6351)

These parameters limit the movement of the Controller Output in all Controlling Modes. These parameters are still operational when the controller is operating in On-Off Control format.* (When parameter XP = 000.0)

*Note: This only applies to the latest versions of the 6350 and 6360 controllers which support the On-Off control facility.

EL Error Limit

(NOT 6351)

This parameter sets a high limit on the value of error seen by the Proportional Term, and effectively determines the point at which the 3-Term Output leaves saturation following a prolonged large deviation, for example, under start-up conditions.

An improvement in the System response can normally be achieved by adjustment of this parameter during tuning of the controller. The user is warned, however, that over-limiting the error will cause an over-shoot.

To disable this function, set EL to 99.99 whereupon the controller will behave as a normal 3-Term Controller.

IF Input Channel Filter Constant

A First-Order filter routine is used to average out the analogue signals feeding into Channels 1 to 3. The Time Constant for this filter can be set to the optimum value using this parameter.

The user should appreciate that adjusting the value of this parameter may alter the characteristics of the control loop, therefore changing the parameter after tuning the loop should be avoided.

The sampling time of each channel is 36ms, dictating the minimum Input Filter Time of 00.04 seconds.

TT Control Element Travel Time

(6351 ONLY)

When this type of controller is being configured, it is necessary to specify in this parameter, the time taken by the Control Element to travel from the fully "closed" to the fully "open" position (or vice versa) under the continuous drive.

TP PID Algorithm Update Period

(6351 ONLY)

This parameter is used to allow the Incremental PID Algorithm to be updated at a faster rate than that determined by the Travel Time of the Control Element.

The rate selected in TP is a critical factor in terms of control loop stability and quality of control.

In general, a sample rate update time approximately twenty times faster than the process response time is required to achieve accurate synthesis of the PID function within the loop.

The sample rate must be at least five times faster than the major process time constants to ensure a rate of information update adequate for control purposes.

TM Minimum Response Time

(6351 ONLY)

This parameter relates to the smallest incremental movement which can be made by the Control Element, in response to a Raise or Lower output pulse from this controller.

Increasing TM beyond this value is equivalent to expanding the Dead-Band on the Control Element and this may cause the Control Element to "Hunt".

The algorithm actually accumulates output pulses of duration less than TM, therefore the minimum output pulse is transmitted by the controller at the "correct" time.

The ratio of **TM** to **TP** sets the minimum rate of travel. This is the effective rate of travel in response to the or Pushbuttons in Manual Mode.

XP Proportional Band Constant

This parameter defines the controller's gain. The parameter is expressed in percentage units where:-

$$Gain = \frac{100}{XP}$$

If XP = 000.0, the gain would be infinite and causes the controller to behave as an On-Off Controller. A special facility has been recently introduced to the 6350 and 6360 Process Controllers to allow a Dead-Band to be specified so that the Controller Output signal can be used to implement On-Off (Bang-Bang) Control.

When On-Off Control is selected by setting XP = 000.0, the Integral and Derivative action is disabled and therefore parameters TI and TD become redundant in this configuration. The Dead-Band is specified in parameter TI whose function changes when XP = 000.0.

Integral Time Constant (if XP > 000.0) or Dead-Band (if XP = 000.0)*

This parameter is adjusted along with the Derivative Time and Proportional Band Constant during tuning of the controller. The units of this parameter are in either minutes or seconds, dependent on the position of Switch SB 2 / SW 8.

The Integral Function can be disabled by setting TI = 00.00.

If parameter XP = 000.0, then this parameter changes its function and is used to specify the Dead Band for On-Off Control. The parameter is expressed as a percentage of the Process Variable span (1H to 1L). The Dead-Band is always below the Setpoint value.

*Note: This facility is only available on recent issues of 6350 and 6360 controllers.

TD Derivative Time Constant

This parameter is adjusted along with the Integral Time and Proportional Band Constant during tuning of the controller. The units of this parameter are either minutes or seconds, dependent on the position of Switch SB 2 / SW 8.

The Derivative Function can be disabled by setting TD = 00.00.

Note that the Derivative Function is calculated from the value of the Process Variable after the action of linearisation and filtering, it is NOT calculated from the Error Term.

SL Local Setpoint

This parameter displays the value of the Local Setpoint Register, which may be viewed by pressing the SP pushbutton on the front panel of the controller.

The value of the Local Setpoint may be changed by writing data into this parameter, provided that the data is within the Setpoint Limits (HS and LS).

RS Ratio Setpoint

This parameter displays the value of the Ratio Setpoint Register, which may be viewed in Ratio Mode only, by pressing the SP pushbutton on the front panel of the controller.

The value of the Ratio Setpoint can be changed by writing data into this parameter, provided that the data is within the Ratio Setpoint Limits (HR and LR).

The Ratio Setpoint can also be adjusted from the front panel in Ratio Mode only. The adjustment is constrained by the Ratio Setpoint limits. If these limits are set to provide a narrow band of adjustment, the Ratio Setpoint control from the front panel becomes coarse.

This limitation has been overcome on the latest issues of 6350 and 6360 Controllers, by restricting the rate of adjustment of the Ratio Setpoint from the front panel to a travel time of 30 seconds between the Ratio Setpoint Limits (parameters HR and LR).

RB Ratio Bias

This is a constant in engineering units which can be added to, or subtracted from, the Resultant Setpoint in Ratio Mode only.

The modulus value of RB must lie within the Process Variable input range (1H and 1L), but the data can be positive or negative.

For Example:

Process Variable Input Range: (-20 to 350 Units)

1H 350.0 1L 020 - 0

For the above range values:

The maximum value of RB = 370.0The minimum value of RB = 370-0 (-370 Units)

Parameter Descriptions

MP Measured Power

This parameter indicates the value of the Measured Power Signal in engineering units.

On recent issues of 6350 and 6360, this facility is selected on Channel 3 by MD > Bit 4 = 1, whereas on the 6351, 6355, 6365 and early issues of 6350 and 6360 this facility is selected using switch SB 2 / SW 2.

OP Controller Output Level

(6350, 6355, 6360, 6365 Only)

This parameter indicates the value of the Controller Output in percentage units.

In Manual Mode it is possible to adjust the Controller Output by writing data into this parameter, provided that the data is within the Output Limits (HO and LO).

6351 Only

The operation of parameter **OP** varies slightly on the 6351 Controller, because the Controller Output signal is not an analogue variable.

The parameter **OP** is always reset to 00.00 after data has been loaded. This parameter can still be used to change the position of the Control Element in Manual Mode, by entering the percentage change required into parameter **OP**.

For example: If the user requires to raise the Output by 10%, the data 10.00 is entered into parameter **OP**, which causes the "Raise", Digital Output Channel to be set High for a time period equal to 10% of the Travel Time specified in parameter **TT**. The "Lower" Digital Output Channel is set High when negative data is entered into parameter **OP**.

Remember the 6351 Controller executes new commands as soon as they are received, with the former command being immediately terminated. Consequently, any current output activity can be immediately terminated by writing to parameter **OP** in Manual Mode.

SP Resultant Internal Setpoint

This parameter is a "Monitor Only" parameter which indicates the value of the controller's Resultant Internal Setpoint (SP), being the sum of the Local Setpoint (SL) and the Local Setpoint Trim (LST):

SP = SL + LST

The Local Setpoint Trim is a variable, ranged by parameters 3H and 3L, whose level is defined by the input voltage applied to channel 3. This provides a defined range of adjustment to the Local Setpoint.

PV Process Variable Input Level

ER Error Value

These parameters are used to transmit the values of these variables to a Computer System for display purposes.

TS PID Algorithm Calculation Period

This parameter indicates the rate at which the PID Algorithm is being calculated. Small variations (+ 10 ms approx.) will be caused when the controller has to send data to a Supervisory Computer along the RS 422 Data Interface.

In the Process Controllers, the actual value of this period varies according to the Integral and Differential time specified within parameters TI and TD, as it becomes unnecessary to recalculate the PID Algorithm when the plant characteristics are slow.

In the 6351 Controller, however, the desired PID Algorithm Calculation period is specified by the user in parameter TP. The actual calculation period in TS will be subject to the same minor variations mentioned above.

SW Switch Bank S1 and S2 Settings

This parameter allows the user to ascertain the positions of switches in Switch Banks SB 1 and SB 2 without removing the controller from the slot.

A

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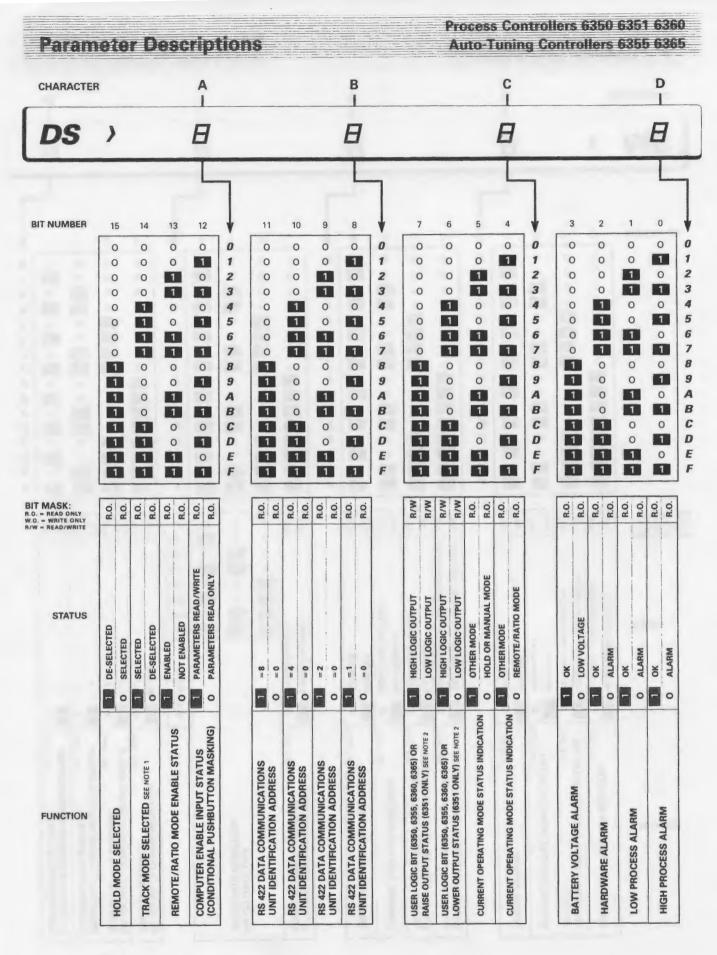
 Note: The previous operating mode is adopted after power failure when the switch SB 2 / SW 5 is in this position.

Note 1

This switch function has been changed on the latest versions of the 6350 and 6360 Controllers.

 Note: The previous operating mode is adopted after power failure when the switch SB 2 / SW 5 is in this position.





Note 1
This bit is unused on 6351 Controller.

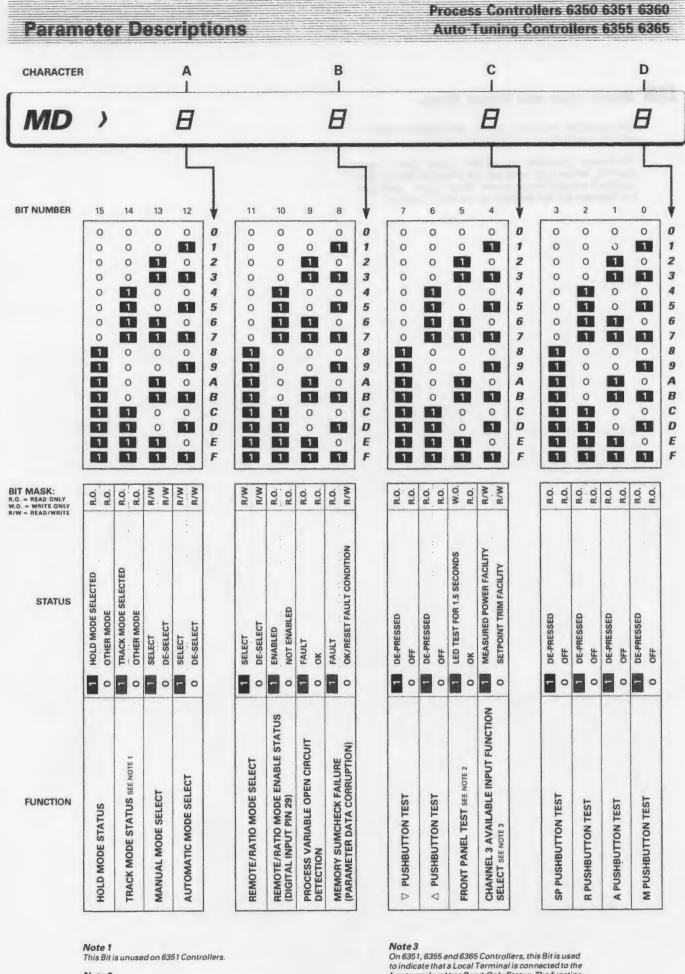
Note 2 This bit has Read-Only status on the 6351 Controller

DS Digital Input and Output States

This parameter allows the user to determine the status of each of the digital input and output channels.

The Process Controllers provide two "spare" digital output channels, whose logic state can be altered by writing data into Bits 7 and 6 of this parameter. These "spare" digital output channels are not available on the 6351 Controller.

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Note 2

The Front panel test facility has not been introduced to 6351, 6355, 6365 and early issues of 6350.

to indicate that a Local Terminal is connected to the front panel and has Read-Only Status. The function of Channel 3 is selected using SB2/SW2.

MD Controller Operating Mode Parameter Sumcheck Failure Front Panel Tests Measured Power Facility Select

Characters A and B

Controller Operating Modes Sumcheck

These two Characters are derived from the status associated with detection and in some cases selection of a controller's operating mode. There are also two Bits used to verify the reason for a Hardware Alarm condition.

The user is warned that this parameter cannot be easily used to identify the controller's current operating mode. Whenever possible, parameter MN should be used for this purpose.

Bit 15 Hold Mode Selected

This Bit indicates if Hold Mode is selected.

Hold Mode is selected when the digital input to Pin 31 is at a **Low** status. This Bit cannot be used to select Hold Mode.

Hold Mode has the highest priority level, therefore this Bit can be used to detect when the controller is operating in Hold Mode.

Bit 14 Track Mode Selected (NOT 6351*)

This Bit indicates if Track Mode is selected.

Track Mode is selected when the digital input to Pin 30 is at a **High** status, consequently this Bit cannot be used to select Track Mode.

Track Mode has the second level of priority. When this mode is selected, the controller will only operate in Track Mode provided that Hold Mode is *not* selected.

*Note: The 6351 controller does not support the Track Operating Mode, therefore this Bit is unused.

Bit 13 Manual Mode Select (See Note 4)

This Bit is used to select Manual Mode from a Computer System, and indicates if Manual Mode has been selected.

Manual Mode can also be selected from the front panel, unless the Pushbutton Mask is enabled. The Pushbutton Mask facility is activated in parameter IC character D.

Manual Mode shares the third level of priority with Automatic and Remote / Ratio operating modes. Track and Hold operating modes will override Manual Mode when they are selected.

Bit 12 Automatic Mode Select (See Note 4)

This Bit is used to select Automatic Mode from a Computer System, and indicates if Automatic Mode has been selected.

Automatic Mode can also be selected from the front panel, unless the Pushbutton Mask is enabled. The Pushbutton mask facility is activated in parameter IC character D.

Automatic Mode shares the third level of priority with Manual and Remote / Ratio operating modes. Track and Hold operating modes will override Automatic mode when they are selected.

Bit 11 Remote Mode Select (See Note 4)

This Bit is used to select Remote or Ratio Mode from a Computer System, and indicates if Remote or Ratio Mode has been selected.

Remote or Ratio Mode can also be selected from the front panel, unless the Pushbutton Mask is enabled. The Pushbutton Mask facility is activated in parameter IC character D.

Remote or Ratio operating mode is a conditional mode of operation which depends on the status of the digital input on Pin 29.

If the input to Pin 29 is **High**, then the controller can operate in Remote or Ratio Mode, but if this input is **Low** then Remote or Ratio Mode is **not** enabled and the controller is forced into Automatic Mode instead.

Bit 11 still remains at **High** Status in this condition, to indicate that Remote or Ratio Mode has been selected. Bit 10 can be used to establish whether the controller is operating in "Forced" Automatic, or Remote / Ratio Mode.

Remote or Ratio Mode shares the third level of priority with Manual and Automatic operating modes. Track and Hold operating modes will override Remote or Ratio Mode when they are selected.

Bit 10 Remote / Ratio Mode Enable Status

This Bit reflects the status of the digital input on Pin 29, which is used to "enable" the controller to operate in Remote operating mode. This Bit can be used to find out if the controller is in Remote / Ratio Mode or "Forced" Automatic Mode.

Bit 9 Open Circuit PV Input Channel

This Bit indicates that the PV Input Channel is open circuit. This condition represents a Hardware Alarm, where the controller is forced into Manual operating mode, unless Track or Hold Mode is selected (these modes have higher priorities). Note that the user will *not* be able to select Automatic and Remote or Ratio modes in this alarm condition.

Note 4: Bits 13, 12 and 11 can be used to select Manual, Automatic and Remote or Ratio modes respectively.

Caution must be exercised when writing data to parameter MD because of the action of these 3 Bits, since these operating modes share the same level of priority.

The user must select, **ONE**, **AND ONLY ONE** of these 3 Operating Modes whenever data is loaded into parameter **MD**.

Note 1

This Bit is unused on 6351 Controllers.

Note 2

The Front panel test facility has not been introduced to 6351, 6355, 6365 and early issues of 6350.

Note 3

On 6351, 6355 and 6365 Controllers, this Bit is used to indicate that a Local Terminal is connected to the front panel and has Read-Only Status. The function of Channel 3 is selected using SB2/SW2.

Bit 8 Parameter Sumcheck Failure

This Bit indicates that the controller has detected a corruption within the data which is stored in the non-volatile area of the Random Access Memory.

Having detected this fault, all controllers except the 6351 Incremental Controller will take the following actions:

- The controller will be forced into Manual Mode, unless the controller is operating in Track or Hold mode, which always override Manual Mode, (these modes have higher priorities).
- The M pushbutton indicator on the front panel continuously flashes in this condition, to indicate that the controller has been "forced" into Manual Mode.
- The Controller Output Limits (parameters HO and LO) are overwritten using the following default data:

HO is set to 99.99 LO is set to 00.00

4. The Controller Output signal level is set by the parameter OP. This parameter may have been corrupted as well, and normally there is no reliable method to recalculate the value therefore:

OP is set to 00.00

If the controller is operating in Track Mode, it is possible to recalculate the value of the Controller Output signal by scanning the input to channel 3. Therefore, in this mode only, the Controller Output signal will remain at the previous level, unless it was constrained by Output limits

The 6351 Incremental Controller follows a different programme of actions after the detection of a data corruption. These actions are as follows:

- The Incremental Controller will be forced into Manual Mode, unless this controller is operating in Hold Mode, which always overrides Manual Mode. (Hold Mode has higher priority).
- The M pushbutton indicator on the front panel continuously flashes in the condition to indicate that the controller has been "forced" into Manual Mode.
- 3. Parameter TT specifies the Control Element Travel Time. This parameter has to be set to the maximum time span which is 327.7 seconds, to ensure that the user has control of the Raise and Lower digital output signals in this condition, therefore:

TT is set to 327.7

4. Parameters TP (Algorithm Update Period) and TM (Minimum Response Time) could affect the operation of the Raise and Lower Controller Output signals in Manual Mode, therefore the following default data is used:

> TP is set to 00.00 TM is set to 00.00

This condition can be cleared on all controllers by the following actions:

- Check all parameters for corrupted data. Note that in some circumstances the user may not find any corrupted parameters, this is because other data is tested as well.
- ii) Reset this Bit to Low status. Remember it is necessary to declare either Manual, Automatic or Remote / Ratio as an Operating Mode during this procedure, even if Track or Hold Mode is selected. Therefore, DO NOT write 0 into Character A and B together: this is illegal.

Characters C and D

Front Panel Tests

These 2 Characters are derived from the status of Bits 7 to 0.

- Bit 7 Pushbutton Test
- Bit 6 Pushbutton Test

These Bits provide the means to check for a switch malfunction. The status of each of these Bits changes as the respective pushbutton is pressed.

If the Hand Held Terminal is used to monitor the status of these Bits, remember that the Hand Held Terminal's Display must be updated at the same time as the pushbutton is pressed.

Bit 5 Front Panel Test Bit

This Bit is used to activate a front panel "Lamp" test, which turns on all the front panel display LED's for about 1.5 seconds. This Bit will always indicate Low status.

Note: On early issues of 6350, and all issues of 6351 and 6355 this Bit will simply indicate that the front panel has a fault which prevents communications with the Micro-processor. This fault will also cause the Watchdog Alarm to trip, and therefore this Bit has virtually no use within these controllers.

Bit 4 Measured Power Display Select (6350 and 6360 Latest Issues Only*)

This Bit is used to select the Measured Power facility on channel 3. This facility changes the display functions of the Digital Readout and the Output Bargraph on the front panel of the controller. When this facility is selected, these displays are used to indicate a signal derived from a transmitter, which is used to check the function of the Control Element or Actuator.

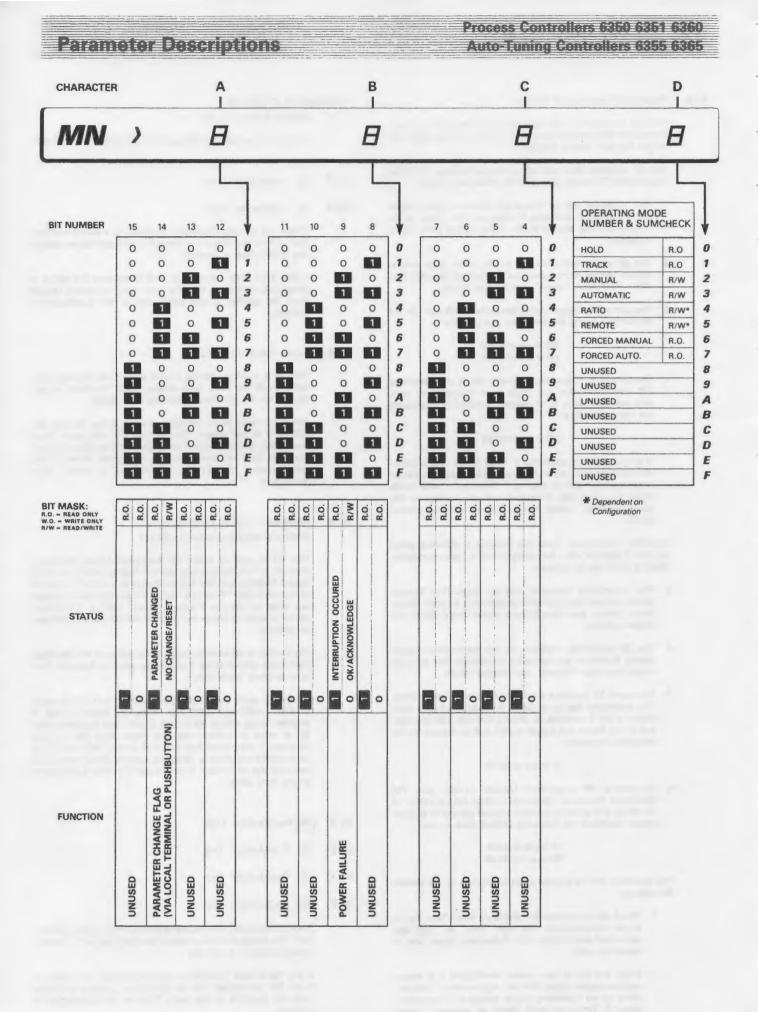
The facility is selected by setting the status of this Bit High. Remember that channel 3 cannot be used for Setpoint Trim to implement Track Mode.

*Note: On early issues of 6350 and 6360, and on all issues of 6351, 6355 and 6365 the Measured Power facility is selected using switch SB 2 / SW 2. On these controllers this Bit is used to indicate that the Hand Held (or a Local) Terminal is connected into the front panel. This facility has very limited use since a computer system cannot communicate with the controllers when a Local Terminal is connected to the front panel.

- Bit 3 SP Pushbutton Test
- Bit 2 R Pushbutton Test
- Bit 1 A Pushbutton Test
- Bit 0 M Pushbutton Test

These Bits provide the means to check for a switch malfunction. The status of each of these Bits changes as the respective pushbutton is pressed.

If the Hand Held Terminal is used to monitor the status of these Bits, remember that the Hand Held Terminal's Display must be updated at the same time as the pushbutton is pressed.



MN Controller Operating Mode Selection Controller Operating Mode Detection Power Failure Flag Parameter Change Flag

This parameter is only supported by Binary Protocol and therefore cannot be inspected from a Local Terminal connected into the front panel of the controller.

Character A

Parameter Change Flag (6350 and 6360 Latest Issues Only)

This character is derived from the status of Bits 15 to 12.

Bit 15 Unused

Bit 14 Parameter Change Flag

This Bit is set when a parameter has been altered from the front panel using either a Local Terminal or the pushbuttons.

This Bit is often used to indicate when someone has changed the operating status of the controller from the front panel pushbuttons.

For clarification, this Bit will be set **High** when any of the following changes occur.

- 1. Adjustment to the Local Setpoint.
- 2. Adjustment to the Controller Output.
- Changes between Manual, Automatic or Remote / Ratio operating modes but NOT between Track or Hold Modes.
- 4. 'Changes to any parameter from a Local Terminal.

The status of this Bit is not affected by a power interruption.

Bit 13 Unused

Bit 12 Unused

Character B

Power Failure Flag (6350 and 6360 Latest Issues Only)

This character is derived from the status of Bits 11 to 8.

Bit 11 Unused

Bit 10 Unused

Bit 9 Power Failure Flag

This bit is set to **High** status when the power supplies to the instrument have been interrupted. This Bit will also be set to **High** status if the Watchdog Alarm is tripped.

Bit 8 Unused

Character C Unused

Character D

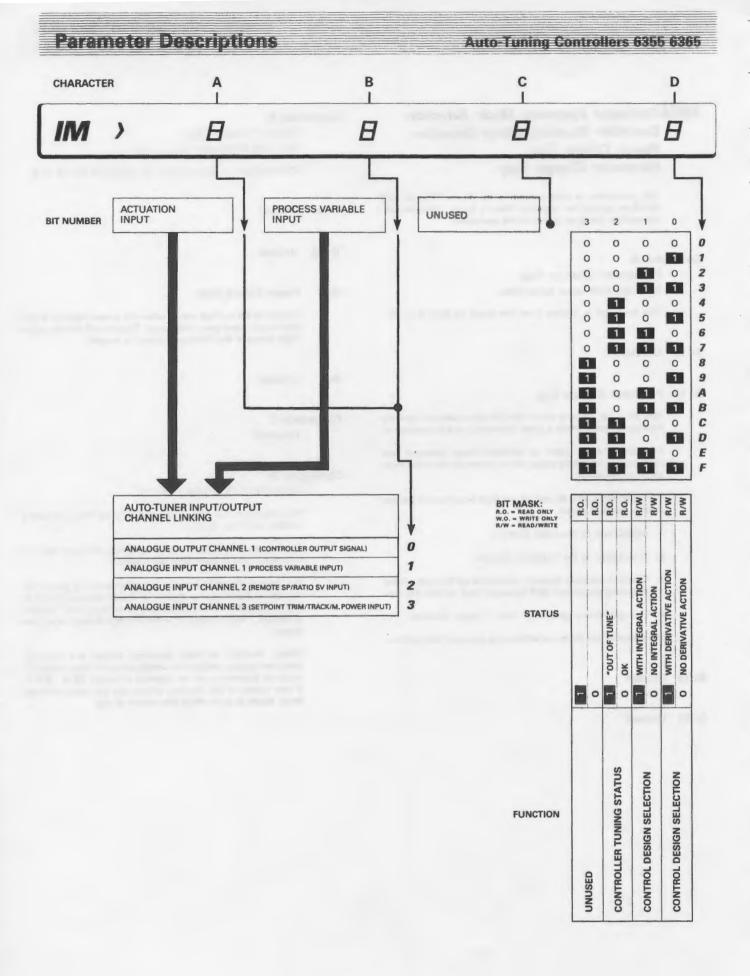
Controller Operating Mode

This character can be used to determine the controller's current operating mode.

The character can also be used to change between Manual, Automatic and Remote or Ratio Modes*.

The user is reminded that the controller will only operate in Remote or Ratio Modes when the digital input to Pin 29 is High, otherwise the controller will default into "Forced Automatic" Mode (Mode 7) while the digital input is at Low status.

*Note: Remote or Ratio operating modes are mutually exclusive options within the configuration of the controller, which is dependent on the position of switch SB 2 / SW 1. If this switch if Off, Remote Mode can be used, whereas Ratio Mode is used when this switch is On.



Page 1. Parameters

PG Parameter Page Selection

This parameter only appears on a Local Terminal plugged into the front panel of the controller, and is used to transfer to the other parameter pages within the controller.

Since this parameter is located outside the path of the parameter scrolling loop on each page, it is only possible to access this parameter directly through the Command Prompt (Character Z).

The parameter will be reset to 0 whenever the Local Terminal is disconnected.

IM Identification Mode

This parameter configures the plant identification inputs used by the Auto-tuner, which allows the controller to be used in the so-called "Piggy-back" format in conjunction with another controller.

Character A

Actuation Input to Auto-Tuner

Normally the Controller Output signal is used as the Actuation input to the Auto-tuner. However, in "Piggy-back" format, the Actuation Input is generally linked into the analogue input to channel 3, so that the Measured Power display facilities can be used. If necessary, the Actuation Input can be linked to any of the three analogue input channels using this character.

Character B

Process Variable Input to Auto-Tuner

This input is always linked to Analogue Input Channel 1 because of the display facilities within the controller. This character offers the facility to change the link to other channels if required.

Character C Unused

Character D

Control Design Selection Controller's Tuning Status

This Character is derived from the status of Bits 3 to 0.

Bit 3 Unused

Bit 2 Controller's Tuning Status

This Bit warns the user that the controller is "Out-of-Tune" which is also indicated by flashing the Digital Readout on the front panel.

The Tuning Status is determined in conjunction with parameters %C (Confidence Factor Threshold) and %X (Recommended 3-Term Constant Variance Level) which are located in Page 2.

During normal operation, the Auto-tuner is frequently redetermining new 3-Term Constants which are calculated from the Plant Model.

The Controller is assumed to be "Out-of-Tune" when percentage variation between the Recommended 3-Term Constants, and the current 3-Term Control Constants exceeds the level specified in parameter "XX, assuming that the Plant Model is sufficiently accurate. Therefore, parameter "CC sets a Low threshold limit on the Confidence Factor, which allows the operation of this facility to be interruped when there is insufficient input data for plant modelling.

Bit 1 Integral Action Disable

Some control loops do not benefit from the use of Integral Action. This Bit allows the user to intercept and block the recommendation of an Integral Constant. However, this Bit does not affect the current value of the Integral Term in parameter TI.

Bit 0 Derivative Action Disable

There are also many control loops which do not benefit from the use of Derivative Action. This Bit allows the user to intercept and block the recommendation of a Derivative Constant. This Bit has no effect on the current value of the Derivative Term in parameter TD.

Page 1. Parameters ... continued

DT Process Delay Time

This parameter is associated with the "Transport Lag" or "Dead Time" exhibited by certain control loops. The parameter is adjusted automatically by the Auto-tuner during the Initialisation Test carried out in Manual Mode. The user may also intervene after this test and change the value in this parameter if required.

The Delay Time is measured in either Minutes or Seconds dependent on the position of switch SB 2 / SW 8 (Off = Seconds).

The Process Delay Time utilises a ring buffer function, where samples are loaded into the buffer at intervals of the Autotuner's Sampling Time (parameter TT).

Any alteration to this parameter will normally cause an initial reduction in the Confidence Factor, whilst the Auto-tuner awaits new data to be clocked through the ring buffer. Restoration of the Confidence Factor should begin after a time period roughly equivalent to twice the value set in parameter DT, provided that realistic changes were made by the user.

AD Setpoint Perturbation Limit

The Auto-tuning facility cannot function unless there is disturbance occurring within the loop causing the Error Value to become dynamic. Traditionally this disturbance is introduced manually by varying the Controller Output signal in Manual Mode, and then switching back to Automatic Mode. In effect, this operation causes a simple variation to the Error Term which could be introduced more easily by changing the value of the Resultant Setpoint in Automatic Mode.

The Auto-tuner provides a facility to introduce these variations to the Resultant Setpoint automatically, in a "random" manner. These variations are called "Perturbations" and the overall magnitude of these Perturbations is maintained within an operating band. The width of this band is specified in engineering units using this parameter.

Setpoint Perturbations are inhibited by setting this parameter to 0000.

ID Identification Test: Process Variable Limit

This parameter is used during the Identification Test only. During this test, a step change is introduced on the Controller Output, which causes the Process Variable to change in value.

The magnitude of change to the Process Variable signal is limited to the value specified in this parameter.

This is achieved in practice by monitoring the Process Variable excursion after the Controller Output has been stepped. When the Process Variable approaches 50% of the value specified in this parameter, the Controller Output signal is stepped in the opposite direction in order to move the Process Variable below the original value. This action is repeated a number of times, with a diminishing size of step each time.

The value entered into this parameter should be equivalent to a typical change in the Process Variable value which occurs during normal plant operation.

OD Identification Test: Actuation Output Limit

This parameter limits the magnitude of step change which is introduced to the Controller Output signal during the Identification Test. This facility is provided as protection for safe plant operation, instead of the simpler possibility of turning the Controller Output either fully On or fully Off during this test.

The Controller Output signal must have sufficient capacity to cause a change in Process Variable which is equivalent to 50% of parameter ID (Process Variable Limit), otherwise the Identification Test will "stall" half-way through.

SL Local Setpoint

OP Controller Output Level

These parameters are repeated from Page 0 for convenience in setting up operating conditions for the Loop, either prior to performing the Identification Test, or for checking the performance with the recommended PID parameters.

Page 1. Parameters ... continued

T? Test Number

This parameter is used to select and initiate the Auto-tuning tests. Only 0, 1, 2 and A are valid data entries in this parameter, and these data characters have the following functions:

Data = 0

Continue Auto-tuning

This is the normal mode of operation, where the Auto-tuner continuously recalculates and updates the Recommended Tuning Constants.

Auto-tuning can also function in Manual or Track Operating Modes as well, but the user must ensure that there is enough activity on the Actuation signal to sustain the Confidence Factor of the Plant Model. In Manual Mode, this activity must be introduced by "hand" control.

In theory, the Plant Model should become more accurate as time progresses, and therefore the Auto-tuning facility has been designed to become gradually less sensitive to large spasmodic disturbances occurring within the loop.

Data = 1

Re-tune for a New Characteristic

This function is used when the characteristic of the loop has altered or when the controller is changed to a different loop. Identification of a new characteristic would otherwise be very slow without this facility.

When this parameter is changed to 1, the controller will flash the data "1" once or twice to acknowledge the change, and then automatically returns to 0.

Data = 2

Identification Test

This test is used to produce some approximate values for the tuning constants of a new loop characteristic. This test cannot be used in the "piggy-back" format.

The concept of this test is very similar to the Cohen and Coon test which is implemented in Manual Mode.

The Identification test causes the Controller Output to change as a step function, producing a change in the Process Variable. The magnitude of the step change is limited by parameter OD during this test.

When the Process Variable approaches 50% of the value specified in parameter ID, the Controller Output signal is stepped again in the opposite direction, in order to move the Process Variable below the original value. This action is repeated a number of times with a diminishing size of step each time.

The data character changes to "F" when this test is finished, and the Process Variable should have returned to the original value. The test data is analysed by the instrument, and then the results are entered into parameters RP, RI, RD, RT, RP. Note that a negative value of data in RP indicates that the 3-term action is incorrect, and the position of SB 2 / SW 4 should be changed.

If the results of this test are poor, the user is advised to check the value entered into DT (Process Delay Time). The Identification Test can be repeated if necessary, or alternatively identification may continue in Manual Mode using test "0", with the user manipulating the Controller Output signal by "hand".

This test can be aborted by entering 0, 1, or A into this parameter. The controller responds by returning the Controller Output signal to the original value and then changes the data statement to "F". The user is now free to select another test.

XP Proportional Band Constant

TI Integral Time Constant

TD Derivative Time Constant

These parameters are repeated from Page 0 for convenience, and can always be directly adjusted by the user.

TT Auto-tuner Sampling Rate

This parameter adjusts the rate at which the PV input signal to the Auto-tuner is scanned. The optimum rate is normally around 10% of the process response time.

This parameter can always be adjusted by the user, although the Auto-tuner recommends the desired setting in parameter RT which is calculated from the Plant Model.

Parameter RT is automatically copied into this parameter when the Recommended Tuning Constants are transferred using parameter U?.

CF Confidence Factor

This parameter is used as a simple "yardstick" to judge the performance of the Plant Model. A good Plant Model can accurately predict the response characteristic of the Process Variable. Therefore, the Confidence Factor is derived by comparing the Predicted Process Variable from the Plant Model, with the actual Process Variable which is fed back from the plant.

A good Plant Model produces a close prediction which is indicated by the Confidence Factor approaching values in excess of 80% under normal circumstances.

The Auto-tuner requires a dynamic Process Variable input signal which is continuously altering in value. A passive signal with no variations is of little use, since it cannot be used to test the behaviour of the Plant Model. For this reason, a passive signal will cause a rapid fall in the Confidence Factor. Artificial plant disturbance can be introduced using the Setpoint Perturbation facility, which is controlled by parameter AD.

Excessive process noise tends to reduce the performance of the Plant Model which is reflected by a low Confidence Factor. The performance can normally be improved in this situation by adjustment of the Input Filter Constant specified in parameter IF.

Page 1. Parameters ... continued

RP Recommended Proportional Band

This parameter indicates the recommended setting for the Proportional Band Constant which is calculated from the Plant Model.

The parameter is updated after the completion of the Initialisation Test, and then is automatically updated at regular intervals during the "continuous" operation of the Autotuning facility in Test 0.

A negative value in this parameter, indicates that Inverse 3-Term Control Action is required, therefore Switch SB 2 / SW 4 should be **On**.

RI Recommended Integral Time Constant

RD Recommended Derivative Time Constant

RT Recommended Auto-tuner Sampling Rate

These parameters indicate the recommended setting for the Integral and Derivative Time Constants and the Sampling Rate of the Process Variable input to the Auto-tuner, which are calculated from the Plant Model.

The parameters are updated after the completion of the Initialisation Test, and then each parameter is automatically updated at regular intervals during the "continuous" operation of the Auto-tuning facility in Test 0.

The time constant range for each of these parameters is limited to 99.99 Seconds when Switch SB 2 / SW 8 = Off, however, this range can be extended to 99.99 Minutes by switching SB 2 / SW 8 Off.

U? Update Current Tuning Constants

This parameter causes the recommended Tuning Constants indicated in parameters RP, RI, RD and RT, to be transferred into the current Tuning Constants in parameters XP, TI, TD and TT. Only 0 and 1 are valid data entries in this parameter, and these characters have the following functions:

Data = 0 Default Data

This is the data which is normally returned in this parameter.

Data = 1 Update Current Tuning Constants

This causes all of the Recommended Tuning Constants to be transferred into the parameters associated with the current "On-line" Tuning Constants.

Data = E Tuning Constant Out-of-Range

This character is returned if a Recommended Time Constant exceeds 99.99 Seconds when switch SW 2 / SW 8 = Off. The transfer of parameters will not take place in this condition.

The position of switch SB 2 / SW 8 has to be altered before the parameters can be transferred. This action will cause the time constants in parameters TI, TD, DT and TT to be measured in units of minutes instead of seconds.

The recommended values in parameters RI, RD and RT are automatically recalculated when the position of this switch is changed, however, this is not the case for parameters TI, TD, DT and TT which remain at their previous values.

This character is also returned when the controller has the wrong 3-Term Control Action selected on switch SB 2 / SW 4. Again the transfer of parameters will not take place until the position of this switch is altered.

Page 2. Parameters

%C Confidence Factor Threshold

This parameter is associated with the determination of the controller's tuning status and is used in conjunction with parameter %X.

The parameter sets a low threshold value on the Confidence Factor. Consequently, the Plant Model is considered to be inaccurate when the Confidence Factor falls below the value of this threshold.

%X Recommended 3-Term Constants Variance Level

This parameter is used in conjunction with parameter %C.

The controller is assumed to be "Out-of-Tune" when the percentage variation between the Recommended 3-Term Constants and the current 3-Term Constants exceeds the level specified in this parameter, assuming that the Plant Model is sufficiently accurate. Therefore parameter %X sets a low threshold limit on the Confidence Factor, which allows the operation of this facility to be interrupted when there is insufficient input data for plant modelling.

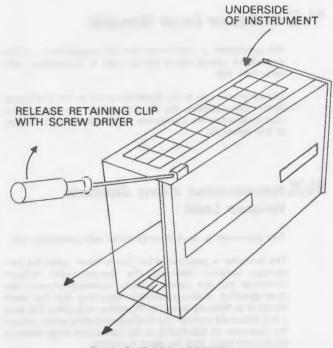
During normal operation, the Confidence Factor should be greater than the value set in parameter %C. Therefore, when the variation between any of the two groups of tuning constants exceeds the level set in this parameter, as a percentage value, the Digital Readout on the front panel, will flash on and off continuously, and parameter IM > Bit 2 will be set to High status.

'A' Series Controllers

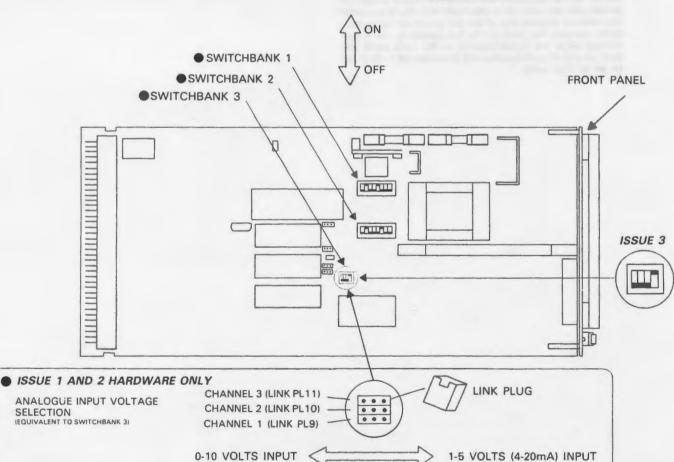
It is necessary to remove the PCB assembly from the instrument sleeve in order to obtain access to the configuration switches in the 'A' series controllers. This is achieved by first releasing the retaining clip as shown in the diagram on the right. The PCB assembly can then be pulled out of the sleeve.

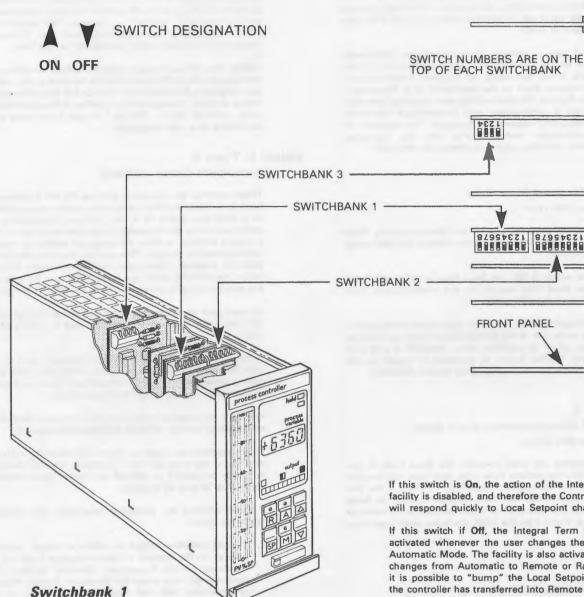
There are three banks of user configuration switches used in this type of controller. The location of these switches are shown in the diagram below.

Note: On Issue 1 and 2 Hardware, the functions of switch bank 3 were implemented using 3 dual position links. The selection positions for each link is shown in the insert to the diagram below. These links were replaced by a switchbank on Issue 3.



PULL OUT PCB ASSEMBLY FROM SLEEVE





Switch 1

Integral Term Balance

This switch allows the user to disable the action of the Integral Term Balance facility, which is activated when the user changes the value of the Local Setpoint in Automatic Mode. Normally a rapid change in the Error Term occurs when the value of the Local Setpoint is changed, and if this change in Error is allowed to be transferred through the 3-Term Control functions, a rapid change to the Controller Output signal is induced by the action of the Proportional Band.

In some applications, where speed of response is a control criterion, it is beneficial to allow the Controller Output signal to respond rapidly to a change of Local Setpoint and in these circumstances, it may be necessary to tolerate a slight over-

However, in the majority of applications a rapid change to the Controller Output signal can cause plant disturbances which are very difficult to control, and these are the situations where the Integral Term Balance facility is used.

If this switch is On, the action of the Integral Term Balance facility is disabled, and therefore the Controller Output signal will respond quickly to Local Setpoint changes.

If this switch if Off, the Integral Term Balance facility is activated whenever the user changes the Local Setpoint in Automatic Mode. The facility is also activated when the user changes from Automatic to Remote or Ratio Modes, where it is possible to "bump" the Local Setpoint. However, once the controller has transferred into Remote or Ratio operating mode, any rapid changes occurring on the input of Channel 2 will be transferred through to the Controller Output signal, because the Integral Term Balance facility is no longer active.

It is important to appreciate the effect of this facility when a control Loop is being tuned. This switch must be On if loop disturbance is introduced by step changing the Local Setpoint through parameter SL, otherwise the response of the Controller Output signal will be damped by the action of the Integral Term Balance function. This will cause the controller to give a deceptive response characteristic.

Switch 2, 3 and 4

Baud Rate Selection (6350 6351 and 6360 Only)

These switches are used to select the Baud Rate on the RS 422 Communications Data Link.

If the instrument is communicating with a Supervisory Computer as part of a large Distributed Control System, the Baud Rate is normally specified at 9600 Baud.

Switchbank 1 ... continued

In general the Baud Rate is only reduced when communicating with devices such as Modems or small computer systems with limited data processing resources. In some exceptional circumstances, the maximum Baud Rate may be affected by the length of communication lines or when low quality cable is used.

The Baud Rate is identical for all Intelligent Instruments connected on the same RS 422 Communication line. If the Baud Rate is set incorrectly by mistake, it will cause a Communications Fault to be registered on a Supervisory Computer System. The fault will be seen when the Computer System tries to communicate with the Intelligent Instrument and subsequently receives no response. The operation of other instruments communicating with the Computer System will normally remain unaffected by this fault.

Switch 2

Local Terminal Baud Rate

(6355 and 6365 Only)

This switch is used to specify the Communications Baud Rate when a Local Terminal is connected to the front panel of the controller.

When this switch is Off, the Baud Rate is set to 300 Baud. This is the Baud Rate required for the communication with the 8260 Hand Held Terminal.

When this switch is **On**, the Baud Rate on the front panel is set to the same rate as the RS 422 Supervisory Communications Line which is specified using Switches 3 and 4 of Switchbank 1. This facility is provided to speed up the graphics which can be displayed on a Local Terminal.

Switch 3 and 4

RS 422 Communication Baud Rate (6355 and 6365 Only)

These switches are used to select the Baud Rate on the RS 422 Communications Data Link, and local communications from the front panel if Switch SB 1 / SW 2= On. The range of Baud Rates has been reduced to four on these instruments. The operation of these switches is the same as switches 2, 3 and 4 on the 6350 which has been previously described.

Switch 5

Protocol Selection*

This switch selects the Communication Protocol used on the RS 422 Communications Data Link to a Computer System.

Binary Protocol is selected when this switch is On. This protocol is designed for use on Supervisory Computer Systems where the data transfer requires to be highly efficient to "speed up" the System Response time. Binary Protocol reduces the structure and format of the parameters for data transmission, therefore, the data has to be reassembled within the Computer System before it can be displayed. Binary Protocol also offers enhancements such as "Enquiry Polling" and "Multi-Parameter Polling" which improve the efficiency of data acquisition.

ASCII Protocol is selected when this switch is Off. In this protocol, the parameter data is transferred as standard ASCII characters, which is less efficient in terms of transfer rates, but far easier to use. ASCII Protocol is generally used on Computer Systems where a slow system response time can be tolerated. ASCII Protocol does not support the additional polling facilities offered on Binary Protocol which are used to increase the efficiency of data acquisition.

If this switch is set incorrectly by mistake, it will cause a Communications Fault to be registered on a Supervisory Computer System. The fault will be seen when the Computer System tries to communicate with the Intelligent Instrument and subsequently receives no response. The operation of other instruments communicating with the Computer System will normally remain unaffected by this fault.

*Note: The very early issues of 6350 and 6351 controllers did not support Binary Protocol, and the function of this switch was originally associated with the RS 422 Communications Group Address. It was possible to define 16 Group addresses using switches SB 1 / SW 8, 7, 6 and 5 on these early controllers (see next paragraph).

Switch 6, 7 and 8

Instrument Group Address

These switches are associated with the RS 422 Communications Data Link. The Data Link operates on the same principle as a Data Bus, where all of the Intelligent Instruments are effectively connected in parallel. Each instrument has to have a unique address to allow the computer system to route a communications dialogue. This address must be specified in both the Intelligent Instrument and the Computer System, which controls the main operation of the bus by initiating any communications dialogue with an Intelligent Instrument.

All Intelligent Instruments provide facilities to specify up to 128 Addresses which are divided up into 8 Groups of 16 Units.

A Single Loop Process Controller is classified as a single Unit. The reader is warned that some Intelligent Instruments have a classification of 4 or sometimes 8 Units, and these will absorb a sequential set of Address Units.

It is very important to make sure that the same Address is not specified on two different Intelligent Instruments.

These switches are used to define the controller's Group Address in the range of 0 to 7 in binary. The Unit Address on these controllers is defined on digital input channels using Pins 24 and 27 inclusive.

If these switches are positioned incorrectly, two different faults can occur:

- If these switches happen to define a unique (unused) address on the System, a Communications Fault will be registered on the Supervisory Computer System. The fault will be seen when the Computer System tries to communicate with the Intelligent Instrument at the expected location address, and subsequently receives no response. The operation of other instruments communicating with the Computer System will remain unaffected in this case.
- Serious problems will result if these switches happen to define an address which is the same as another Intelligent Instrument.

In the worst case this may completely lock up the whole RS 422 Data Communication line. This would cause Communication Faults to be reported on all Intelligent Instruments linked on this Communication line. All of the affected Intelligent Instruments, with the exception of the two Instruments with conflicting Addresses, will usually function in their normal "Autonomous" condition with no indication of the fault condition on their front panels.

Under normal circumstances, however, this fault causes parameters in both of the Instruments with the conflicting addresses to become corrupted. In most cases this should cause a communication fault to be reported on a Computer System as soon as a parameter is changed, but there are some circumstances where a fault may not be identified in this situation.

Switch Functions

Switchhank 2

Switch 1

Ratio Configuration Select

This switch changes the standard configuration of the Controller. The switch is used to select Normal or Ratio Configuration which alters the principal operation of the analogue input on channel 2.

When this switch is Off, Channel 2 is used as the Remote Setpoint input. Remote Mode can be selected in this configuration, either from the front panel or by using Parameter MD > Bit 11, but the digital input on Pin 29 must be High to allow the controller to operate in Remote Mode.

In Remote Mode, the analogue signal coming in on Channel 2 is processed and then linked to the Local Setpoint which is subject to the action of Setpoint Limits. This switch also affects the operation of the analogue input Channel 3. When Setpoint Trim is selected (Parameter MD > Bit 4, or Switch SB 2 / SW 2*), the signal is used to trim the Local Setpoint.

When this switch is **On**, the function of Channel 2 is altered to become the Wild or Secondary Variable input for use in Ratio Control applications. Ratio Mode is substituted for Remote Mode and uses the same method for selection and indication on the front panel.

In Ratio Mode the Local Setpoint follows the "derived" Setpoint calculated from the input to Channel 2, which is processed and then multiplied or divided by the Ratio Setpoint.

The Ratio Setpoint can be adjusted from the front panel in Ratio operating mode. When Setpoint Trim is selected (parameter MD > Bit 4 or Switch SB 2 / SW 2*), the signal is used to trim the Ratio Setpoint. There is also a facility to Bias the Ratio Setpoint by a constant entered into parameter RB.

*Note: The 6351, 6355 and 6365 and early issues of 6350 and 6360 controllers, the Measured Power facility is selected using switch SB 2 / SW 2.

Switch 2 (a)

Controller Output Action Select (6350 and 6360 New Issues Only)

This switch reverses the action of the Controller Output Signal.

- i) When this switch is Off, Normal Action is selected. This means that as the parameter OP increases towards 100%, the Controller Output Signal increases to 10 Volts or 20 mA.
- iii) When this switch is On, Reverse Action is selected. In this case, as the parameter OP increases towards 100%, the Controller Output Signal reduces to 0 Volts 4 mA.

This is generally used in conjunction with Reverse Action Actuators which fail to the "Open" instead of a "Closed" condition.

When this switch is On, the front panel displays still indicate the actual position of the Control Element, so that increasing the value of Parameter OP should still cause the Control Element to "Open" rather than "Close".

Note that the Track Signal Input on Channel 3 will correspond with the same voltage level as the Controller Output Signal, even though the Parameter **OP** reflects the actual position of the Control Element.

It is very important to understand the difference between the action of this switch which alters the action of the Controller Output Signal and the affect of Switch SB 2 / SW 4 which alters the 3-Term Output action.

Switch 2 (b)

Measured Power Display Select

(6351, 6355 and 6366 Only) (Early Issues of 6350 and 6360*)

This switch is used to select the Measured Power facility on Channel 3. This facility changes the display functions of the Digital Readout and the Output Bargraph on the front panel of the controller. When this facility is selected, these displays are used to indicate an analogue signal derived from a Transmitter which is used to check the function of the Control Element or Actuator.

The facility is selected when this switch is On. Remember that Channel 3 cannot be used for Setpoint Trim when this switch is On, and it should not be possible to select Track Mode (i.e. The digital input on Pin 30 must be Low).

*Note: On recent issues of 6350 and 6360 controllers, this facility is selected on parameter MD > Bit 4.

Switch 3

Inverse Ratio Setpoint Select

This switch determines whether the Ratio Setpoint multiplies or divides the Secondary or Wild Variable.

Switch 4

3-Term Controlling Action Select

This switch determines the action of the 3-Term Output in response to a change in the Error Term.

Note:

The reader is warned that non-conventional definitions have been adopted by TCS for defining the Error Term and 3-Term Controlling Action.

The Error Term, Parameter ER is defined as:

Error = Process Variable - Setpoint or ER = PV - SP

If this switch is in the **Off** position, when the Error becomes negative, the 3-Term Output calls for more power and hence, the 3-Term Output signal increases. This is termed **DIRECT** 3-Term Action.

If this switch is in the **On** position, when the Error becomes negative, the 3-Term Output calls for reduced power and hence the 3-Term Output signal decreases. This is called **INVERSE** 3-Term Action.

DO NOT confuse the function of this switch with the function of switch SB 2 / SW 2 on the latest issues of the 6350 and 6360 Controllers. This switch (SW 4) only affects the operation of the controller in Automatic and Remote or Ratio Modes, it has no effect in Manual or Track Modes.

It is also worth redefining the difference between the Controller Output signal, and the 3-Term Output:

The 3-Term Output is the output from the PID function, whereas the Controller Output is the signal which is transmitted from the instrument.

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Switchbank 2 ... continued

Switch 5

Failure Actions

This switch determines the action of the controller in two different conditions.

1. Open Circuit Process Variable Input

The Analogue Input Channel 1 has an additional component to sense if the input is open circuit.

When the condition is detected, there is a delay of about 5 seconds, where the Controller Output will be frozen at the current value if the controller is operating in Automatic or Remote / Ratio modes.

After 5 seconds, the digital output on Pin 18 trips to Low status and the appropriate action will be taken, according to the position of this switch.

2. Power Failure

A power failure is generally represented by the loss of the voltage supply to the controller for a time period in excess of 20 ms. In the event of this fault, the controller resumes operation in a co-ordinated manner which is determined by the position of this switch.

Note that the same "start-up sequence" is also initiated after a Watchdog Alarm has been cleared.

Switch 5 = Off

If this switch is Off the following actions occur:

Open Circuit PV Input Signal.

- 1. The Controller is forced into Manual Mode.
- There is no change to the level of the Controller Output signal.
- If Track or Hold Mode is selected, the controller will continue to operate in either of these modes, since the operation is not affected by the loss of the signal to Channel 1. (Note: There is no integrity test on the Analogue Input to Channel 3).

Power Interruption

- The controller resumes operation in the same operating mode.
- There is no change to the level of the Controller Output signal.

Switch 5 = On

If this switch is On, the following actions will occur:

Open Circuit PV Input Signal

- 1. The Controller is forced to select Manual Mode.
- If Track or Hold Mode is selected, the controller will continue to operate in either of these modes since the operation is not affected by the loss of the signal to Channel
 (Note: There is no integrity test on the Analogue Input to Channel 3).
- 3. a. (6355, 6365, Early Issues of 6350, 6360 Only)

The Controller Output value is "closed off" by setting parameter $\mathbf{OP} = \mathbf{LO}$ (Low Output Limit) unless Manual, Track or Hold Mode is selected.

b. (6351 Only)

The Controller Output signal is "closed off" by setting the Lower digital output channel **High** for a time period which is equal to parameter TT (Control Element Travel Time), *unless* Manual or Hold Mode is selected.

c. (6350 and 6360 Latest Issues Only)

The action of the Controller Output signal in these controllers depends on the Controller Output Action selected on SB 2 / SW 2:

- (i) SB 2 / SW 2 = Off (Normal Controller Output Action). The Controller Output value is "closed off" by setting parameters OP = LO (Low Output Limit) unless Manual, Track or Hold mode is selected.
- (ii) SB 2 / SW 2 = On (Reverse Controller Output Action). The Controller Output value is "Opened Up" by setting parameter OP = HO (High Output Limit) unless Manual, Track or Hold Mode is selected.

Power Interruption

- 1. Manual operating mode is selected on power-up.
- There is no change to the level of the Controller Output signal if the controller is operating in Track mode.
- 3. a. (6355, 6365, Early Issues of 6350, 6360 Only)

The Controller Output value is "closed off" by setting the parameter OP = LO (Low Output Limit).

b. (6351 Only)

The Controller Output signal is "closed off" by setting the Lower digital output channel **High** for a time period which is equal to parameter **TT** (Control Element Travel Time).

c. (6350 and 6360 Latest Issues Only)

The action of the Controller Output Signal in these controllers depends on the Controller Output Action selected on SB 2 / SW 2:

- (i) SB 2 / SW 2 = Off (Normal Controller Output Action). The Controller Output value is "closed off" by setting parameter OP = LO (Low Output Limit).
- (ii) SB 2 / SW 2 = On (Reverse Controller Output Action). The Controller Output value is "opened up" by setting parameter OP = HO (High Output Limit).

SWIGIT THE LONS

Switchbank 2 ... continued

Switch 6

Local Setpoint Tracking Facility

When this switch is Off, the Local Setpoint remains at a constant value in Manual, Track and Hold Modes, and the value can be adjusted from the front panel of the controller, or by writing to Parameter SL.

When this switch is **On**, the Local Setpoint follows the value of Parameter **PV** in Manual, Track and Hold Modes, and therefore the Local Setpoint cannot be altered from the front panel or by writing to Parameter **SL**.

This facility has no effect on the Local Setpoint in Automatic or Remote / Ratio modes, and the reader is reminded that Setpoint Limits are active in all controlling modes.

Switch 7

Channel 3 Output Function

(6350, 6351 and 6360 Only)

This switch is used to select the variable which is transmitted on the analogue output Channel 3.

When this switch is Off, the Resultant Setpoint value (parameter SP) is transmitted.

When this switch is **On**, the value of the Deviation between the Resultant Setpoint and the Process Variable *multiplied by 8* is transmitted. An offset of 5 Volts is added to this value so that both positive and negative Deviation values are followed. This is a very useful facility to use in conjunction with a Chart Recorder when tuning the controller. The multiplication factor of 8 is not adjustable, and the output voltage from this channel is limited between 0 and 10 Volts.

(6355 and 6365 Only)

This switch is used to select the variable which is transmitted on the analogue output Channel 3.

When this switch is Off, the Resultant Setpoint value (parameter SP) is transmitted.

When this switch is **On**, the Predicted Process Variable signal is transmitted. The facility can be used to record progress of the plant identification in order to assess the quality of the Plant Model.

Switch 8

Parameter TI and TD Time Units

This switch is used to select the time units for the Integral and Derivative functions. The switch has no effect on the Input Filter Time constant.

Switchbank 3*

Switch 1

Channel 1 Analogue Input Voltage Select Process Variable Input

Switch 2

Channel 2 Analogue Input Voltage Select Remote Setpoint / Ratio PV Input

Switch 3

Channel 3 Analogue Input Voltage Select Setpoint Trim / Track / Measured Power Input

These analogue input channels are designed to interface directly with a 0 to 10 Volt input signal. The inputs are connected to pins 13, 14 and 15 for channels 1, 2, and 3 respectively.

An additional signal conditioning circuit is also provided on each input channel, in order to interface with the common 4 to 20 mA signal standard. A 250 Ohm Burden Resistor is used to convert this current into a voltage range of 1 to 5 Volts.

The 1 to 5 volt input signal is fed into the signal conditioning circuit and converted to a 0 to 10 volt signal. The signal is linked internally to the inputs of the analogue processor.

Switches SB 3 / SW 1, 2, and 3 isolate the output of the signal conditioning circuit and therefore prevent this output from interfering with the signal levels of a 0 to 10 volt input signal.

The respective switch must be closed (On) when the 1 to 5 volt interface is used, and open (Off) when the 0 to 10 volt interface is required.

The 0 to 10 volt input channels on pins 13, 14, and 15 must not be linked to 0 volts when the 1 to 5 volt input is used.

*Note: These switches are replaced by dual position links in the 'A' Series controllers.

Fault Finding Hints

SYMPTOM	FAULT	DESCRIPTION	PAG
	General Operation Faults		
Symptom 1	Flashing M Pushbutton	M Pushbutton indicator flashing on the front panel	47
1-0	Automatic, Remote/Ratio Modes Inhibited	User cannot select Automatic or Remote/Ratic operating modes	
Symptom 2	Controller Output Signal Clamped	User cannot change the level of the Controller Output signal	47
Symptom 3a	Flashing PV Bargraph (6360, 6365)	Continuously flashing PV Bargraph on the front panel of the 6360 or 6365 Controllers	47
	Flashing Deviation Bargraph (6355)	Continuously flashing Deviation Bargraph on the front panel of the 6355 Controller	
Symptom 3b	Flashing Deviation Bargraph (6350, 6351)	Continuously flashing Deviation Bargraph on the front panel of the 6350 or 6351 Controllers	47
Symptom 4	Control Element Action Reversed	The Control Element moves in the wrong direction in Manual mode when the M and A pushbuttons are pressed on the front panel	48
Symptom 5	Poor Control	Poor control of the process in Automatic or Remote/ Ratio modes	41
Symptom 6	Setpoint Offset	The Resultant Setpoint seems to be offset with respect to the Local Setpoint, viewed when pressing the SP pushbutton on the front panel, or by inspecting parameter SL	45
Symptom 7	Remote/Ratio Modes Inhibited	User cannot select Remote/Ratio modes	4:
Symptom 8	Plant Disturbance in Automatic Mode	Plant disturbance can occur after the Local Setpoint has been changed in Automatic mode	4
Symptom 9	Flashing Digital Readout (6355, 6365)	Continuous flashing of the Digital Readout on the front panel of the Auto-tuning Controllers	4
Symptom 10	Pushbutton Inhibited	No action on a front panel pushbutton	4
Symptom 11	Blank Displays	All displays blanked except for the green "Power On" indicator in the centre of the Deviation Bargraph on the 6350, 6351 or 6355 controllers	5
		All displays blanked except the bottom 2 bars on the PV and SP bargraph on the 6360 and 6365 controller.	
Symptom 12	Flashing Decimal Points	Unused Decimal Points continuously flashing on the front panel of the controller	5
Symptom 13	Intermittant Watchdog Alarm	Watchdog Trips out occasionally	5
	Controller "Falls Back" into Manual Mode	Controller drops into Manual Operating mode with the Controller Output set to the "failsafe" limit	

SYMPTOM	FAULT	DESCRIPTION	PAG
	Communication Faults		
Symptom 14	Hand Held Terminal Fault	Hand Held Terminal will not initialise to show the command prompt display ("?? CMD")	51
Symptom 15	Communications Fault	Controller will not communicate with a Supervisory Computer on the RS 422 Data Link	51
Symptom 16	Parameter Data Masked	Parameter Data cannot be changed from a Supervisory Computer communicating on the RS 422 Data Link	52
	Typical Transmitter Interface Problems		
Symptom 17	Inaccurate Readings	Inaccurate input reading on the Process Variable display	52
Symptom 18	Endscale Input Readings	Endscale readings derived from 1 to 5 Volt input signals	52
Symptom 19	No Open-circuit Input detection	No Open-circuit Input detection on the Process Variable input when a 0 to 10 Volt signal is used	52
	Typical Control Problems		
Symptom 5	Poor Control	Poor control of the process in Automatic or Remote/ Ratio modes	48
Symptom 8	Plant Disturbance in Automatic Mode	Plant disturbance can occur after the Local Setpoint has been changed in Automatic mode, and can also occur after changeover into Remote or Ratio modes	45
Symptom 20	Irratic Disturbance on Controller Output Signal	The Controller Output signal suddenly jumps to an indeterminate value. The fault is intermittent, and occurs in Automatic, Manual and Remote/Ratio operating modes	52

TRAINING MANUAL
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Flashing M Pushbutton

M Pushbutton indicator flashing on the front panel.

Automatic, Remote / Ratio Modes Inhibited

User cannot select Automatic or Remote / Ratio operating modes.

Cause

These faults can be caused by either:-

- An Open Circuit Process Variable input signal on channel 1.
- 2. A parameter corruption (Sumcheck Failure).

The actual cause of the fault can be verified by inspecting the status of parameter MD > Bits 9 and 8.

Remedy

- Check the Process Variable input wiring to the instrument.
- Check each parameter for data corruption then set parameter MD > 2000. (Note: entering MD > 0000 will not clear the fault condition)

If this fault recurs, the instrument should be replaced. See also Symptom 12.

Symptom 2

Controller Output Signal Clamped

User cannot change the level of the Controller Output signal.

Cause

- Is the Controller in Hold Mode? Check if the "Hold" indicator on the top right hand corner of the front panel is On.
- 2. Are parameters HO and LO set correctly?
- Is the Controller in Track Mode? Check if the Track indicator on the top right hand corner of the front panel is On.

Assistance

- The Controller Output signal cannot be adjusted in Hold Mode. Hold Mode is de-selected when the digital input to Pin 31 is taken High, connecting a link between Pin 9 and Pin 31 is the normal practice if Hold Mode is not required.
- 2. Check parameters HO and LO.
- The Controller Output signal cannot be adjusted from the controller if Track Mode is selected. In Track Mode, the Controller Output follows the level of the analogue signal coming in on Channel 3. Track Mode is selected when the digital input on Pin 30 is High.

Symptom 3a.

Flashing PV Bargraph (6360 6365)

Continuously flashing PV Bargraph on the front panel of the 6360 or 6365 Controllers.

Flashing Deviation Bargraph (6355)

Continuously flashing Deviation Bargraph on the front panel of the 6355 Controller.

Cause

A Process Alarm limit has been exceeded.

Assistance

- Check the settings of the Absolute Alarm limits set in parameters HA and LA.
- Check the values of the Deviation Alarm Limits set in parameters HD and LD.

Remember, to disable the Deviation Alarms, a value which is equal to the span of the Process Variable input range (1H – 1L) should be entered into parameter HD and LD as required. Do not enter 0000 into parameters HD or LD.

Symptom 3b.

Flashing Deviation Bargraph (6350 6351)

Continuously flashing Deviation Bargraph on the front panel of the 6350 or 6351 Controllers.

Cause

A Process Alarm limit has been exceeded.

Assistance

Check the values of the Deviation Alarm limits set in parameters HA and LA.

Remember, to disable the Deviation Alarms, a value which is equal to the span of the Process Variable input range (1H – 1L) should be entered into parameter HA and LA as required. Do not enter 0000 into parameters HA or LA.

Symptom 4

Control Element Action Reversed

The Control Element moves in the wrong direction in Manual mode when the M and pushbuttons are pressed on the front panel.

Cause

The action of the Actuator has been reversed. (Generally, this is to achieve safe plant operation.)

Remedy

- This problem is overcome on the 6351 Incremental Controller, by swopping over the connections to Pin 22 ("Lower" Controller Output Signal) and Pin 23 ("Raise" Controller Output Signal).
- On the recent issues of 6350 and 6360 Controllers this problem is overcome by changing the position of switch SB 2 / SW 2 which reverses the action of the controller Output signal.

The user is advised to check the issue of software before changing the position of this switch, as this facility has only been introduced to the recent issues of software.

As a reminder – Parameter II character D indicates the software issue which has been installed, except on the 6350 controllers prior to issue 6 where parameter II had not been introduced into the parameter list. See Software History for more information.

There is no remedy for this problem on the 6355 and 6365 Controllers and the early issues of the 6350 and 6360.

The only possible solution to this problem on these Controllers requires two special labels to be added to the front panel. These labels should be positioned above each end of the Output Bargraph display to indicate the "Open" and "Closed" condition.

Symptom 5

Poor Control

Poor control of the process in Automatic or Remote / Ratio modes.

Fault

- 1. The 3-Term Control Action is incorrect.
- 2. The controller has not been tuned properly.
- 3. The control loop characteristics have changed.

Remedy

1. Change the position of switch SB 2 / SW 4.

Note that this switch has no effect on the operation of the controller in Manual mode.

2. Re-tune the controller.

Very often, users forget to disable the action of the Integral Term Balance facility when tuning the controller.

The Integral term can be balanced automatically when changes to the value of the Local Setpoint occur in Automatic mode.

This facility should be disabled when tuning the controller by switching SB 1 / SW 1 = On.

If the switch is incorrectly set in the Off position, the controller will be tuned with a tight Proportional Band. This will produce an underdamped control characteristic which can cause the control loop to go unstable when subjected to plant disturbances.

This does not apply to 6355 and 6365 Auto-tuning controllers where the action of the Intergral Term balance facility has no effect on the performance of the Auto-tuning facilities.

If the characteristics of the process have altered, it will be necessary to re-tune the controller to compensate for changes which have taken place.

There are no circumstances which can cause the 3-Term constants to "slip" over prolonged periods of operation. The calibration of the 3-term constants in a microprocessor based controller is not dependant on components such as capacitors or resistors, which tend to "age" over a period of time.

Setpoint Offset

The Resultant Setpoint seems to be offset with respect to the Local Setpoint, viewed when pressing the SP pushbutton on the front panel, or by inspecting parameter SL.

Cause

The action of the Local Setpoint Trim facility.

Remedy

Check the settings in parameters 3H and 3L. To disable the Setpoint Trim facility, set parameters 3H and 3L to 0000.

Remember that parameters 3H and 3L are also used in conjunction with the Measured Power Facility. This facility is selected using switch SB 2 / SW 2 on all controllers, except the latest issues of 6350 and 6360 controller, where parameter MD > Bit 4 is used instead.

Symptom 7

Remote / Ratio Modes Inhibited

User cannot select Remote / Ratio modes.

Cause

Remote / Ratio Mode is not enabled.

Assistance

Remote or Ratio Mode is a conditional mode of operation. The digital input to Pin 29 must be High in order to allow the controller to operate in Remote or Ratio mode.

Symptom 8

Plant Disturbance in Automatic Mode

Plant disturbance can occur after the Local Setpoint has been changed in Automatic mode, also can occur after changeover into Remote or Ratio modes.

Cause

The action of the Integral Term Balance facility has been disabled. This facility causes the Integral Term to be balanced automatically when the value of the Local Setpoint is changed in Automatic mode, or whenever the controller is transferred into Remote or Ratio mode.

The Integral Term Balance facility cancels out the effect of the Proportional Band which normally induces a rapid change to the Controller Output signal in this situation.

Remedy

The Integral Term Balance facility is enabled when switch $SB\ 1\ /\ SW\ 1\ =\ Off.$

Symptom 9

Flashing Digital Readout (6355 6365)

Continuous flashing of the Digital Readout on the front panel of the Auto-tuning Controllers (6355 and 6365).

Cause

The Controller is "Out of Tune" due to a change in the characteristic of the control loop which can be brought about by one of the following factors:-

- Parameters %C (Confidence Factor Threshold) or %X (Recommended 3-Term Constant Variance Level) are incorrectly set.
- b. Process Disturbance or Upset.
- c. Change of operating point or fluid characteristic.
- d. Change in demand.
- e. Transmitter Fault.
- f. Actuator Fault.
- g. Control Element Fault.

Remedy

First establish why the Control Loop characteristic has changed, then check the Recommended Tuning Constants before transferring these values into the parameters associated with the current "On line" Tuning Constants.

Symptom 10

Pushbutton Inhibited

No action on a front panel pushbutton.

Cause

- 1. Action of the Pushbutton Masking facility.
- 2. Component failure on the controller.

Remedy

- 1. Check the setting of parameter IC character D.
- Check the action of each pushbutton using parameter MD > Bits 0, 1, 2, 3, 6 and 7.

Remember when using a local terminal to monitor parameter MD, the actual pushbutton being tested must be pressed at the same time as the local terminal display is updated by pressing the "Q" key.

Blank Displays (6350 6351 6355)

All displays blanked except for the green "Power On" indicator in the centre of the Deviation Bargraph on the 6350, 6351, or 6355 controllers.

Blank Displays (6360 6365)

All displays blanked except the bottom 2 bars on the PV and SP bargraph on the 6360 and 6365 controller.

Cause

The watch-dog alarm has been tripped, which can occur when a component has failed or when the input power supply voltage has dropped below specification.

Remedy

Normally it is reasonable to assume that a component failure has occurred when the Watchdog alarm has been tripped. The controller should be replaced.

The action of the Controller Output signal must be taken into account before the instrument is removed from the slot in this condition.

If this fault recurs after the instrument has been replaced, the power supply voltage should be suspected and therefore carefully checked.

The Watchdog Alarm is automatically cleared as soon as the fault which tripped the alarm is cured. The controller will resume operation in a manner which is defined by switch SB 2 / SW 5. This is the same start up sequence which occurs when the instrument is powered up.

Notes

A watchdog alarm resets all Digital Output Channels to Low status. The signal from each Analogue Output Channel will be maintained at the previous level for a short time, (provided that the power supply has not been interrupted). However, these analogue signals will gradually drift towards zero in this condition, at a rate no greater than 1% every 3 minutes.

All output signals from Intelligent Instruments will drop to 0 Volts when the power supply is interrupted or when the instrument is removed from the slot.

If necessary, there are two possible ways to provide backup facilities to support the Controller Output signal in this situation:-

- Automatic backup facilities can be provided in a number of different ways using equipment powered from an alternative source.
- iii) An alternative manual backup facility can also be provided in the form of a portable battery powered Manual Backup Unit (TCS Product: 8550), which is plugged into a special socket located underneath the controller on the front panel. This unit can support a control signal for approximately 12 hours.

Symptom 12

Flashing Decimal Points

Unused Decimal Points continuously flashing on the front panel of the controller.

Cause

The battery test has failed.

(The long life battery supports the Random Access Memory when the instrument is un-powered.)

Remedy

Replace the battery.

Notes

The battery is load tested every 10 minutes during normal operation and is not rechargeable.

If this test fails, normal operation will continue until the power supply is interrupted.

When power is restored, the controller normally detects corrupted data in the Random Access Memory. This fault represents a Hardware Alarm and initiates the appropriate failure sequence.

It is possible to clear the Hardware alarm condition when the battery has failed. The user must first check all configuration parameters for corrupted data, and then clear the Sumcheck Bit in parameter MD by entering the data MD > 2000. This will allow Automatic and Remote / Ratio modes to be selected, until another power interruption occurs or the battery is replaced.

Symptom 13

Intermittant Watchdog Alarm Controller "Falls Back" into Manual Mode

Watchdog Trips out occasionally, or Controller drops into Manual Operating mode with the Controller Output set to the "failsafe" limit.

Cause

Both of these symptoms can be caused by the following problems:-

- Short interruptions to the controller's power supply which exceed half-of-one mains cycle (1 ms).
- A controller operating just inside the minimum voltage tolerance, but dips out of tolerance for short periods of time.

Remedy

- Try to establish the cause of these interruptions. Sometimes a Constant Voltage Transformer can cure this problem.
- 2. Increase the input supply voltage to the controller.

Advice

Do not use Switch SB 2 / SW 5 in the "On" position when any of these problems are experienced. This will cause the controller to "drop" into Manual Mode with the Controller Output signal set to the safe Output Limit, whenever a power interruption occurs.

Hand Held Terminal Fault

Hand Held Terminal will not initialise to show the command prompt display ("?? CMD").

Cause

- 1. Intermittent or broken cable connection.
- 2. Incorrect Baud rate.
- 3. Controller hardware fault.

Remedy

 There are two "dots" which are located on the bottom right hand side of the Hand Held Terminal Display. These dots continuously flash on and off whenever the Hand Held Terminal is correctly connected into the front panel of the controller.

If the connecting cable is faulty, the two dots will not appear on the Hand Held Terminal Display.

The baud rate for the local terminal is selected using switches SB 1 / SW 2, 3 and 4 on the 6355 and 6365 Controllers.

The Hand Held Terminal communicates at 300 Baud which is selected when switch SB 1/ SW 2 = Off.

If the local terminal baud rate is not set to 300 Baud, the two dots will continue to flash, but the other characters on the Hand Held Terminal Display will remain blank.

A component failure in this area of the controller generally causes the Watchdog Alarm to trip.

Symptom 15

Communications Fault

Controller will not communicate with a Supervisory Computer on the RS 422 Data Link.

Causes

- Local Terminal connected into the front panel of the controller.
- 2. RS 422 Communication Baud Rate incorrectly set.
- 3. Incorrect Communications Address.
- 4. Incorrect Communications Protocol selected.
- 5. RS 422 Transmission line wiring fault.
- 6. Component failure on the controller.
- Communications protocol fault on the Supervisory Computer.

Remedy

- 1. Obvious
- 2. Check the settings of switches SB 1 | SW 2, 3 and 4.
- Check the settings of switches SB 1 / SW 6, 7 and 8 which specify the "Group" Address of the controller.

Also check the status of digital inputs on Pins 24, 25, 26 and 27 which specify the "Unit" address of the controller.

4. Check the setting of switch SB 1 / SW 5.

Note that the early issues of 6350 and 6351 controllers did not support Binary Protocol. Refer to "Software History" for more details.

The most common wiring fault is the omission of the 0 Volt Power connection on the RS 422 data line.

Check that the Transmission and Receiving line "pairs" have not been swopped over by mistake, and also check the polarity connections are correct for each pair.

Operating the data link at 9600 Baud is unlikely to cause problems on links which are less than 100 Meters in length, provided that good quality cable is used and the correct terminating resistance is fitted.

A component failure on the controller itself is unlikely to have occurred unless the Watchdog Alarm has tripped.

The communications port on the controller can be quickly proved by checking that it is possible to access data using a Hand Held Terminal plugged into the front panel.

Having proved the operation of the communications port, any further problems are more likely to be caused by external faults, provided items 1 to 5 have been checked.

With new installations, remember that a communications problem can be caused by the Supervisory Computer itself.

The Communications protocol should be proved by connecting a single controller directly on to the RS 422 communication port on the Supervisory Computer. Start off by polling the instrument and checking that data is returned.

If no control character or data is returned by the controller, check the communications Baud Rate on the Supervisory Computer, then check the operation of the RS 422 Data Port. A Dual Trace Oscilloscope connected to the RS 422 Receive and Transmit lines can be very useful for fault finding at this stage.

When serial data appears to be returned by the controller, the problem may be associated with the handling of communications within the Supervisory Computer. If a "NAK" control character (Negative Acknowledgement) is returned by the controller, check the computation of the Parity Bits and the "BCC" control character (Binary Checksum).

Parameter Data Masked

Parameter Data cannot be changed from a Supervisory Computer communicating on the RS 422 Data Link.

Cause

The digital input on Pin 28 is Low (Computer Enable).

Remedy

Connect a link between Pin 9 (Watchdog Alarm output – a source of 15 Volts) to Pin 28. All parameters have Read-only status when Pin 28 is Low. When Pin 28 is High, it is possible to alter parameters with Write status from the RS 422 Data Link.

Pin 28 does not prevent the user changing parameters from a Local Terminal connected to the front panel.

Symptom 17

Inaccurate Readings

Inaccurate input reading on the Process Variable display.

Cause

- 1. Wrong Linearisation routine selected on channel 1.
- 2. Link PL9 or Switch SB 3 / SB 1 incorrectly set.
- 3. Wiring fault.
- 4. Controller calibration error.

Remedy

1. Check the setting of parameter IC character A.

Some types of thermocouple or PRT signal converters transmit a "Linearised" output signal. There is always a risk of linearising a signal twice when this type of transmitter is used.

Check that Link PL9 is set for 0 to 10 Volts operation, or that switch SB 3 / SW 1 is Off when the Process Variable input is derived from a 0 to 10 volt input signal on Pin 13.

This prevents the output from the 1 to 5 volt Signal Conditioning circuit interfering with the 0 to 10 volt input to Pin 13.

 On new installations, check that the transmitter has been connected to 0 Volt Reference and not 0 Volt power by mistake. This will cause measurement inaccuracies, particularly on systems with bulk DC power supplies.

This problem can also occur when the 0 Volt Reference line passes excessive current to Earth due to another fault in the system.

4. If the calibration of the controller is suspect, the controller should be removed and checked using a test rack, a stable voltage source and a suitable 5 digit Digital Volt Meter. Remember to measure all voltages directly on the module pins during this test.

Symptom 18

Endscale Input Readings

Endscale readings derived from 1 to 5 Volt input signals.

Causes

- 1. Switches SB 3 / SW 1, 2 or 3 incorrectly set.
- Input signal connected to Pins 13, 14 or 15 instead of Pins 10, 11 or 12 respectively.
- 3. No Burden resistor connected.
- 4. Pins 13, 14 or 15 connected to 0 Volts.

Remedy

- Check the settings of switches SB 3 / SW 1, 2 and 3. The respective switch should be "On" if the 1 to 5 volt input is required for the channel.
- Remember that 1 to 5 volt input signals come in on different pins to the 0 to 10 volt signals for each input channel.
- The reader is reminded that Burden Resistors are not fitted inside the controller.
- Pins 13, 14 and 15 must not be connected to 0 Volts when a 1 to 5 volt input signal is used.

Symptom 19

No Open-circuit Input Detection

No Open-circuit Input detection on the Process Variable input when a 0 to 10 Volt signal is used.

Cause

Link PL9 or Switch SB 3 / SB 1 incorrectly set.

Remedy

Check that Link PL9 is set for 0 to 10 Volts operation, or that switch SB 3 / SB 1 is Off.

Symptom 20

Erratic Disturbance on Controller Output Signal

The Controller Output signal suddenly jumps to an indeterminate value. The fault is intermittent, and occurs in Automatic, Manual and Remote / Ratio operating modes.

Cause

Excessive pickup of noise on the digital input to Pin 30 causing the controller to enter Track Mode for a very short period of time. However, this time is long enough to allow the input to Channel 3 to be scanned and the Controller Output signal to be adjusted accordingly.

This fault will cause the Controller Output to suddenly jump to the value of the input to Channel 3, which generally introduces a plant disturbance for no apparent reason.

Remedy

Connect the input to Pin 30 (and all other unused digital input channels) to Pin 3 (0 Volt Power).

MODULE PIN No.	UNIVERSAL SYSTEM TERM. No.	7900 SLEEVE TERM. No.	7600 BIN TERM. No. TA 7950	DESIGNATION	FUNCTION	
1 2	1, 2, 3, 4	12, 13, 14, 39	16, 17, 18, 19	OV REF	OV REFERENCE	
3	5, 6, 7, 8	40	14, 34, 43	OV POW	OV POWER	
4	0, 0, 1, 0	40	14, 04, 40	071011	01.011211	
5						
6						
7	11			+15V OUT	+15 VOLTS SUPPLY	
		20	15		DC SUPPLY INPUT (24V)	
8	9, 10	30 29	15 13, 28	DC SUPP IN (20-30V) W. DOG OUT (1)	WATCHDOG TIMER OUTPUT	
	12	25	10, 20	11.000001(1)	WATGIDGG TIME!	
10	17	2	1	PV IN (1-5V)	PROCESS VARIABLE	4-20mA OR 1-5V CONDITIONED
11	18	3	2	REM. SP. IN (1-5V)	REM. SETPOINT/RATIO P.VAR	ANALOGUE INPUTS
12	19	4	3	SP. TRIM IN (1-5V)	S.P. TRIM/TRK/MEAS. PWR.	
12	20	16	21	PV IN (0.10V)	PROCESS VARIABLE	0-10V DIRECT
13	20	16	31	PV. IN (0-10V)	PROCESS VARIABLE REM. SETPOINT/RATIO P.V.	ANALOGUE INPUTS
14	21	17	32	REM. SP. IN (0-10)	S.P. TRIM/TRK/MEAS. PWR.	
15	22	18	33	SP. TRIM IN (0-10V)	S.F. TRIIVI/TRY/VICAS. PVK.	
16	23	21	20	HI. ALM. OUT (0)	HIGH ALARM OUTPUT	
17	24	22	21	LO. ALM. OUT (0)	LOW ALARM OUTPUT	at man
18	25	23	22	HW. ALM. OUT (0)	HARDWARE ALARM OUTPUT	
19	26	24	23	BAT. LOW. OUT (0)	BATTERY VOLTAGE LOW	8-WAY 0-15V
20	27	25	24	REM. AUT. OUT (0)	REM.AUT./RATIO STAT, OUT	DIGITAL OUTPUTS
21	28	26	25	HLD + MAN OUT (0)	(HLD + MAN) STAT, OUT	
22	29	27	26	BIT 1 OUT	USER LOGIC BIT 1	
23	30	28	27	BIT 2 OUT	USER LOGIC BIT 2	
		-				
24	31	31	5	ADD 1 IN (1)	20 - 1	
25	32	32	6	ADD 2 IN (1)	21 - 2 UNIT ADDRESS	
26	33	33	7	ADD 4 IN (1)	2 ² = 4 INPUTS	
27	34	34	8	ADD 8 IN (1)	23 = 8	8-WAY 0-15V DIGITAL INPUTS
28	35	35	9	COMP. EN. IN (1)	COMPUTER EN. INPUT	DIGITAL IN 013
29	36	36	10	REM. SP. EN. IN (1)	REM. SP./RATIO EN. INPUT	
30	37	37	11	TRACK EN. IN (1)	TRACK ENABLE INPUT	
31	38	38	12	HOLD EN. IN (0)	HOLD ENABLE INPUT	
						0-10V
32	39	6	40	CON. OUT	CONTROLLER OUTPUT	NON-ISOLATED
33	40	7	38	PV. OUT	PROCESS VARIABLE OUTPUT	ANALOGUE OUTPUTS
34	41	8	39	SP/DEV. OUT	SP/DEVIATION OUTPUT	
35	13, 42	9	29	XMT. OUT ()	TRANSMIT OUTPUTS	RS422
36	14, 43	10	30	XMT. OUT (+)	TRANSMIT OUTFORS	SUPERVISORY
	-					SERIAL DATA BUS
37	15	19	44	RCV. IN (-)	RECEIVE INPUTS	be I T
38	16	20	45	RCV. IN (+)		
39				200 PM		
40	47	11	35	TX. SUPP (-)	TOANICAUTTED GLIDDING	
41	48	1	36	TX. SUPP (+)	TRANSMITTER SUPPLY	
42		7 35		3 40 5		
43	44	15	41	CON. OUT ISOL (-)		
44					ISOLATED 4-20mA	
45	45	5	42	CON. OUT ISOL (+)	CONTROLLER OUTPUT	
46					Access to the same and	
47						
48						
					1	RELAY AND MAINS
		41		NO	HIGH	CONNECTIONS
		42		W	ALARM	ONLY APPEAR ON THE 7350 SLEEVE
		43		NC	RELAY	(relay contact
		44		NO	LOW	designations are for the
		45		w	ALARM	non-energised
		46		NC	RELAY	or alarm state)
	1					
		47		EARTH		
		48		NEUTRAL	AC MAINS	

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6350 Process Controller

ISSUE/ RELEASE DATE	CHANGES	DETAILS
ssue 1	Prototype	For evaluation.
Issue 2	Initial release	The 6350 was the first Intelligent Instrument developed by TCS, and was one of the first micro-processor based Process Controllers on the market.
ssue 3	Linearisation introduced	
Issue 4 Feb 82	Parameter List restructured	Parameter structure and general presentation improved to current standard.
Issue 5 Mar 82	Binary Protocol added	
1010	Setpoint Limits	Parameters HS and LS remain active in Ratio Mode.
	Analogue output resolution	Improved by a factor of 8.
	3-Term output	The 3-Term Output characteristic has been improved to eliminate "kick-back" oscillations which can occur on the departure from an Output limit. This is caused by the action of the Integral Term, and intensifies as the proportional band is reduced.
	PID Algorithm Calculation Period	The rate at which the PID algorithm is scheduled has been increased on slow response characteristics. This will be particularly significant in Minutes Mode, (Switch SB2/SW8 — On) where the calculation period has been reduced from about 1.5 minutes (worst case) to about 12 seconds. This change improves the "initial" response time of the Controller Output signal in Automatic and Remote/Ratio modes.
	Integral Term Balance	This facility has been introduced to allow the action of the Integral Term Balance to be inhibited on Local Setpoint changes. This facility is enabled using switch SB1/SW1.
	Memory Sumcheck Failure Actions	Parameters are no longer reset to 0000 following the detection of a corrupted parameter (this does not apply to parameters HO, LO and OP).
	Open Circuit PV detection	There is now a three second delay before any action is taken, following the detection of an open circuit PV input on channel 1.
	Instrument Identification Parameter Mode Identification Parameter	Parameters II and MN have been added to the parameter list. These parameters are only accessible through Binary Protocol.
	Pushbutton Masking	A pushbutton masking facility has been introduced which is activated in parameter IC character D.
	User Defined Linearisation Tables	Up to five User Specified Linearisation Tables can now be stored.
		continued

...continued

6350 Process Controller

ISSUE/ RELEASE DATE	CHANGES	DETAILS
Issue 6 Nov 85	Controller Output Action	A facility to reverse the Controller Output Action from the Manual Station has been introduced. This provides the correct display interface when the controller is used in conjunction with Reverse Acting Valves. The facility utilises switch SB2/SW2.
	Measured Power Display	The Measured Power Display facility is now selected in parameter MD > Bit 4.
	Ratio Setpoint Adjustment	The adjustment of the Ratio Setpoint from the front panel has been improved. It now takes 30 seconds for the Ratio Setpoint to travel from limit to limit when the adjustment is made from the front panel.
	On-Off Control	An On-Off control facility has been introduced. This is selected by setting parameter XP — 000.0. The Dead Band (always below the Setpoint), is set as a percentage of PV range (1H-1L) using parameter TI whose function changes when XP — 000.0.
	Parameter "Change of State" Bit	A parameter "Change of State" Bit (Bit 14) and a Power Failure Bit has been introduced to parameter MN > Bit 9.
	Power Failure Bit	A front panel lamp (LED) Test Bit has been introduced to parameter MD > Bit 5.
Issue 8 Oct 87	6350A Controller Introduced	Uses single motherboard hardware.

HA 078079

6351 Incremental Controller

ISSUE/ RELEASE DATE	CHANGES	DETAILS
Issue 1	Prototype	For evaluation.
Issue 2	Initial release	
Issue 3 Aug 82	Incremental Control Algorithm	Performance of Incremental Control algorithm optimised.
Issue 4 Jun 83	Binary Protocol introduced	74,000
Issue 5 May 84	Setpoint Limits	Parameters HS and LS now remain active in Ratio Configuration.
Issue 8 Oct 87	6351A Incremental Controller Introduced	Uses single motherboard hardware.

HA 078080

6355 Auto-Tuning Controller

ISSUE/ RELEASE DATE	CHANGES	DETAILS	
Issue 1 Jul 84	Initial release		
issue 8 Oct 87	6355A Auto-tuning Controller Introduced	Uses single motherboard hardware.	

HA 078081

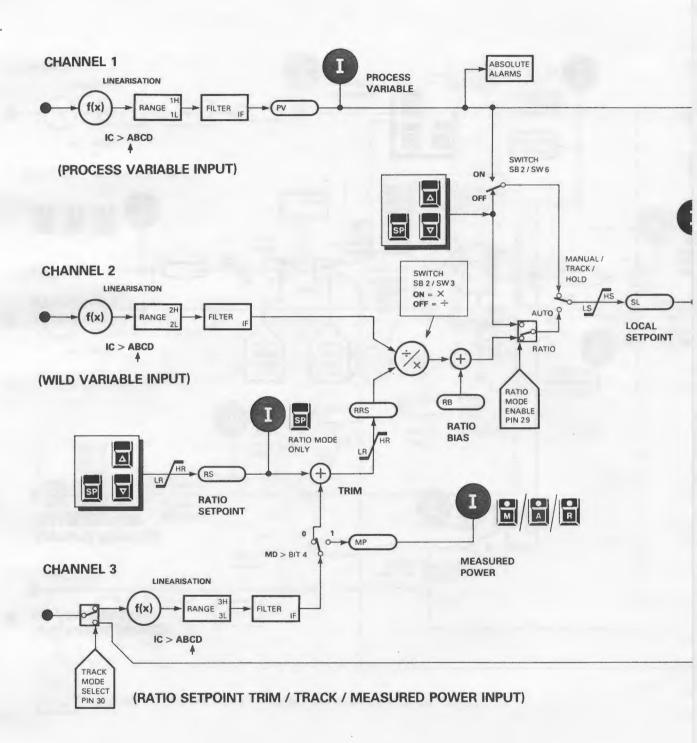
6360 Process Controller

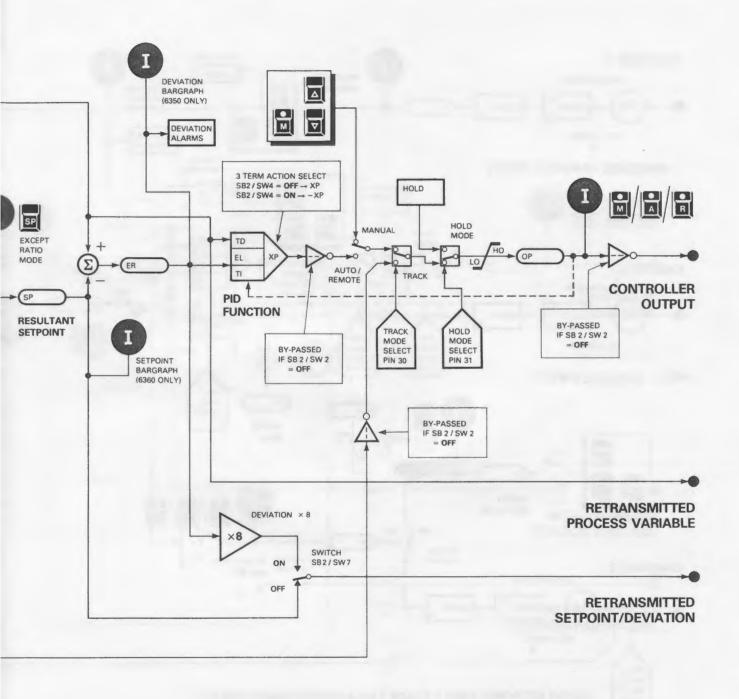
ISSUE/ RELEASE DATE	CHANGES	DETAILS
Issue 1 Jun 83	Initial release	
Issue 2 Nov 85	Controller Output Action	A facility to reverse the Controller Output Action from the Manual Station has been introduced. This provides the correct display interface when the controller is used in conjunction with Reverse Acting Valves. The facility utilises switch SB2/SW2.
	Measured Power Display	The Measured Power Display facility is now selected in parameter MD > Bit 4.
	Ratio Setpoint Adjustment	The adjustment of the Ratio Setpoint from the front panel has been improved. It now takes 30 seconds for the Ratio Setpoint to travel from limit to limit when the adjustment is made from the front panel.
	On-Off Control	An On-Off control facility has been introduced. The facility is selected by setting parameter XP — 000.0. The Dead Band (always below the Setpoint), is set as a percentage of PV range (1H-1L) using parameter TI whose function changes when XP — 000.0.
	Parameter "Change of State" Bit	A parameter "Change of State" Bit (Bit 14) and a Power Failure Bit (Bit 9) has been introduced to parameter MN.
	Power Failure Bit	A front panel lamp (LED) Test Bit has been introduced to parameter MD > Bit 5.
Issue 8 Oct 87	6360A Controller Introduced	Uses single motherbaord hardware.

6365 Auto-Tuning Controller

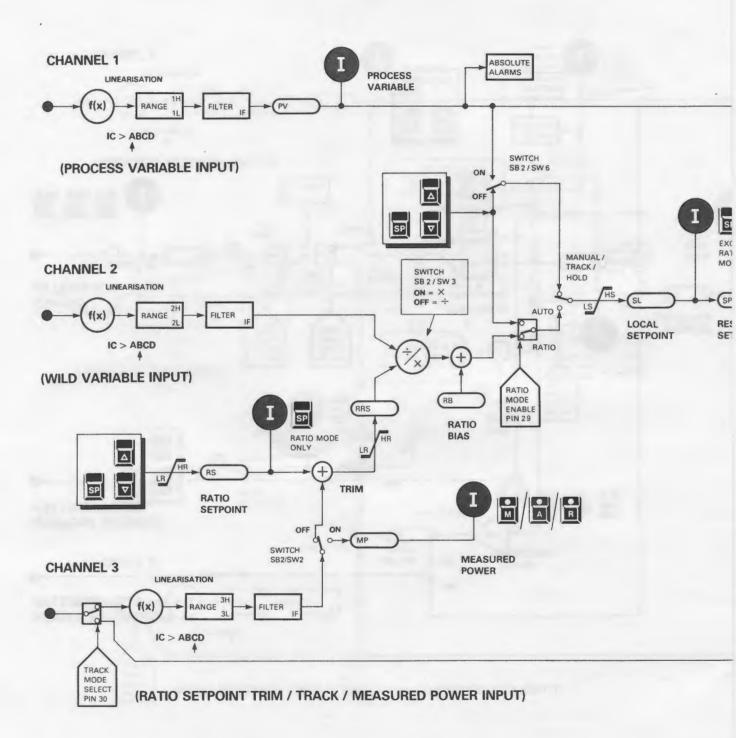
ISSUE/ RELEASE DATE	CHANGES	DETAILS
Issue 1 Jun 85	Initial release	
Issue 8 Oct 87	6365A Auto-tuning Controller Introduced	Uses single motherboard hardware.

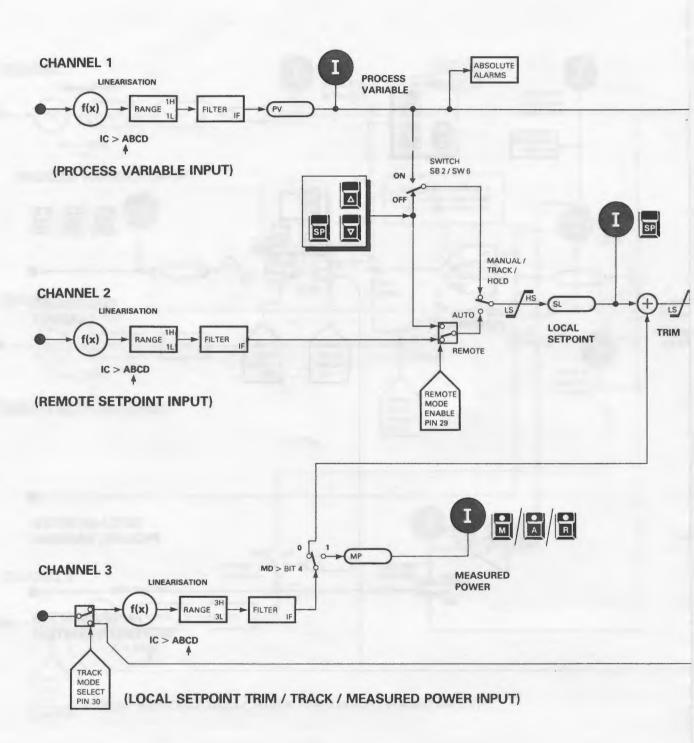
info@ageltec.co.uk

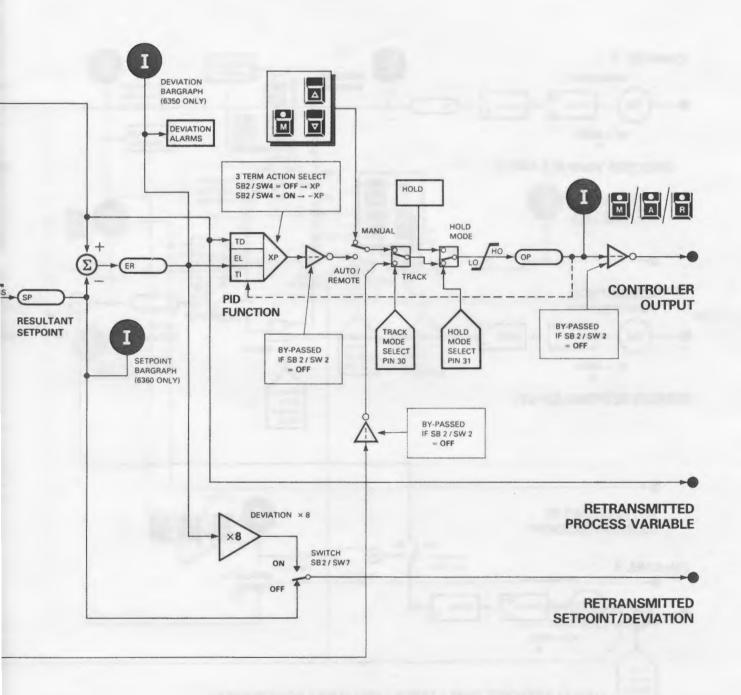




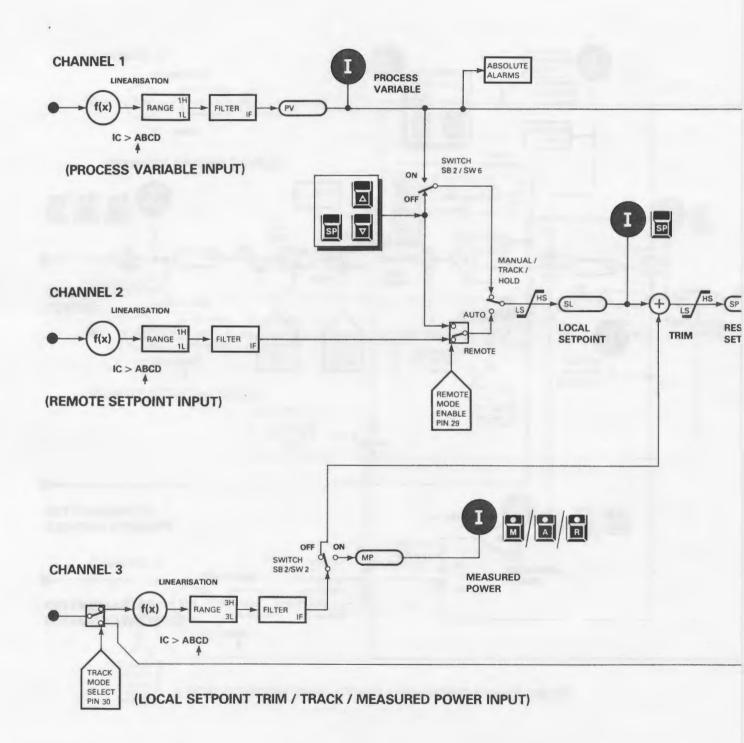
6350/6360 Current Issues. Ratio Configuration

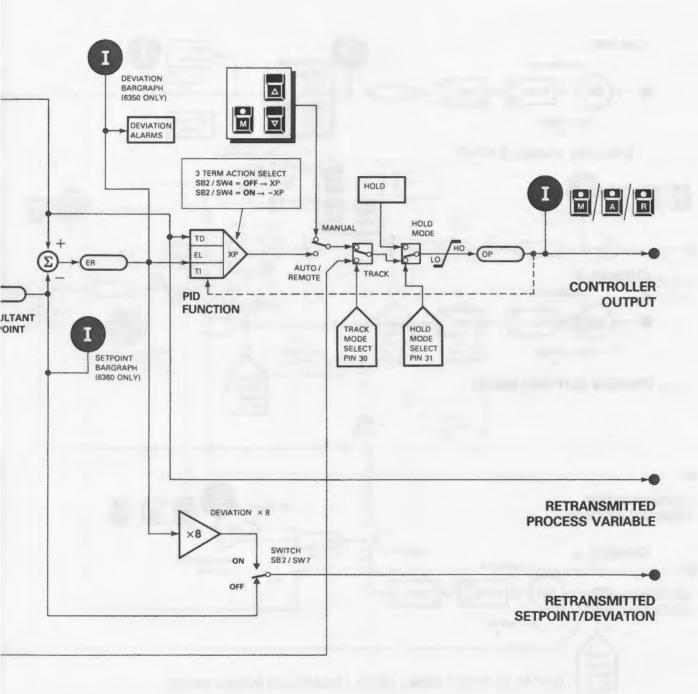




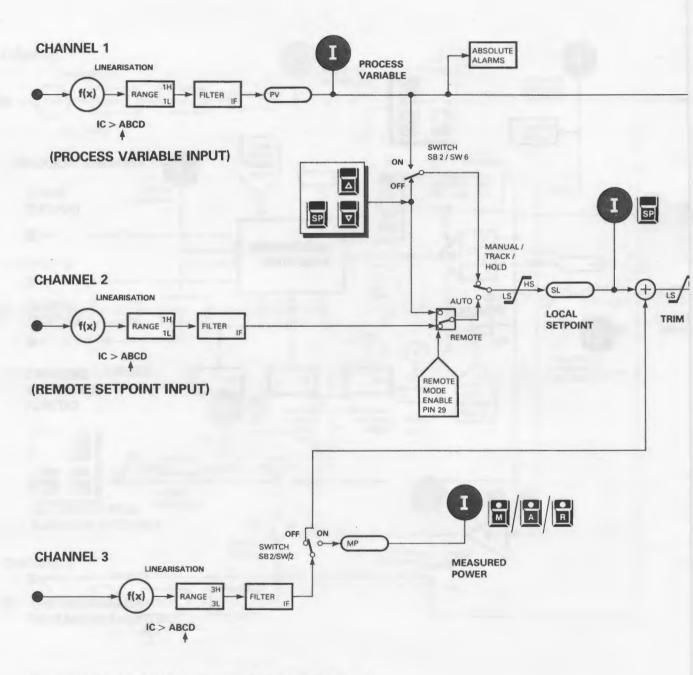


(Master) 6350/6360 Current Issues. Normal Configuration

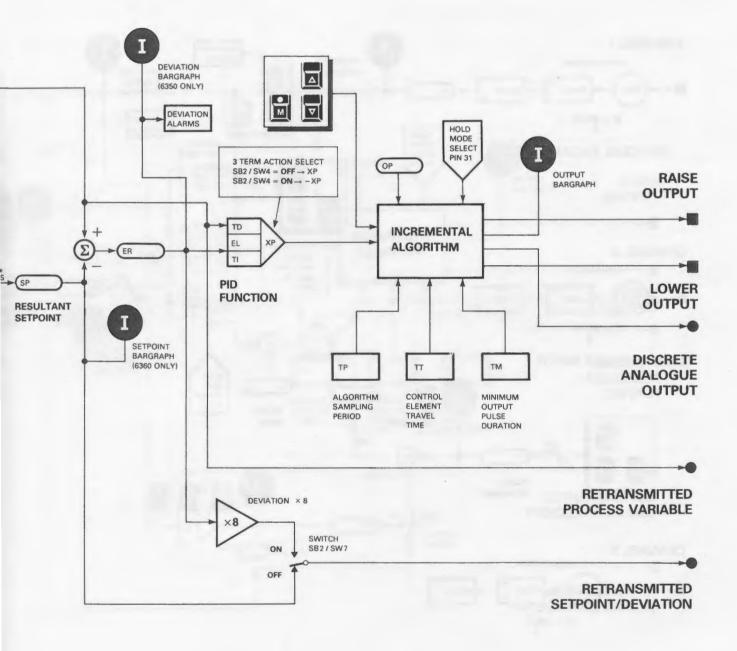




6350/6360 Early Issues of Software. Normal Configuration



(LOCAL SETPOINT TRIM / MEASURED POWER INPUT)



6351 Current Issue. Normal Configuration