PID Function Block

User Guide

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Preface

Scope of the User Guide

This user guide provides basic information about the PID function blocks. This information helps users to create program code for a MOX system application. It is expected that the user is an engineer or similar with an understanding of the operating and programming requirements of the intended MOX system components.

Related Documents

A MOX system contains a collection of MOX equipment and several software packages. For this reason, a number of related documents should be read in conjunction with this guide.

The related documents are noted below:

- MoxGRAF User Guide
- MOX Open Controller User Guide
- MOX Unity Field Controller User Guide
- MOX IoNix Field Controller User Guide

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1 Overview

MoxGRAF provides PID function blocks to extend the functionality of the MOX Open Controller, MOX Unity and MOX IoNix.

Function Block Name	Description
PID	Balancing function between the theoretical input and the real time input
CLogic	Encoding operation to compress all Boolean type inputs into one DINT type output
Servo	Output speed rate controlling
LeadLag	Lead and Lag functions
Addition	Addition function
Multiply	Multiplication function
Divider	Division function
ParamReader	Read other function block's internal parameters
ParamWriter	Modify other function block's internal parameters
Participation	Split the input into the maximum of four outputs
Switch	Select ideal incoming source through an input parameter
Runback	Provide a tracking runback value service
DemandLimit	Provide flow control service
DEB400	Control and coordination of the turbine with the boiler
SEL2	Decided for those devices with one redundancy output and need to export to a device with mono-input only
SEL3	Select the most proper value for output
Accumulate	Accumulate input value
HILOALM	High, Low limit alarm
HILOEALM	Provides limit alarm service with limit calibration
SGP	Export saturated water capacity from a corresponding input pressure value
Characterizer	Analyze a non-linear input
BCA	Provide binary control algorithm
VCPT	Stream gas converter
Inertia	Inertia with offset
Rate	Project rate with input sample period
RateLimit	Project rate with rate limit check
MoxPID	PID Controller
MoxPIDII	PID Controller

Table 1 PID Function Blocks within MoxGRAF

2 Function Blocks

2.1 PID

This “PID” function block mainly provides a balancing function between the theoretical input (Local Set Point) and the real time input (Process Value). PIDs try to control their difference near zero. The PID provides Force Back and Feed Forward function for balancing those input values. PIDs also take Common Logic from the CLogic function block for better balancing control. This PID has four selectable calculation methods: Normal PID with Direct effect, Normal PID with Reversed effect, Differential First PID with Direct effect and Differential First PID with Reversed effect. When any unexpected error occurs in Auto mode, a user could read those problems through the Auto Mode Warning (AMW). Each bit of AMW represents different problems. The AMW Definitions table shows what each bit represents.

2.1.1 Operation Formula

1) Regular PID

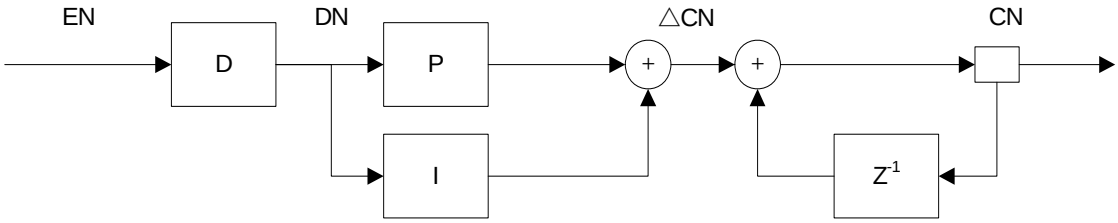


Figure 1 Regular PID Process

Formula of figure 1:

$$C_N = \frac{100}{P}(1+\frac{1}{T_I S})(\frac{1+T_D S}{1+\frac{1}{8}T_D S})E_N$$

Note: C_N is the PID output, P is the Ratio, and TI is the Integral constant.
T_D is the Derivative constant, En is the Difference.

2) Derivative First PID

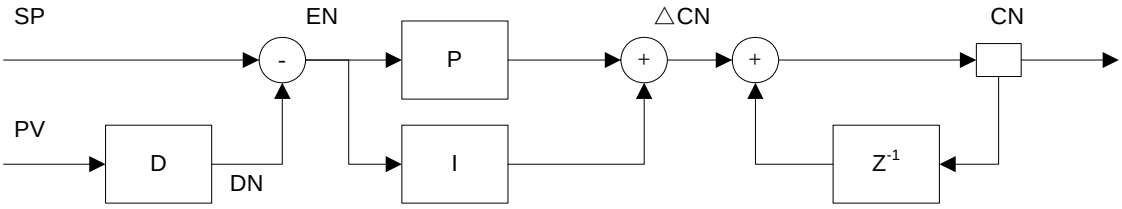


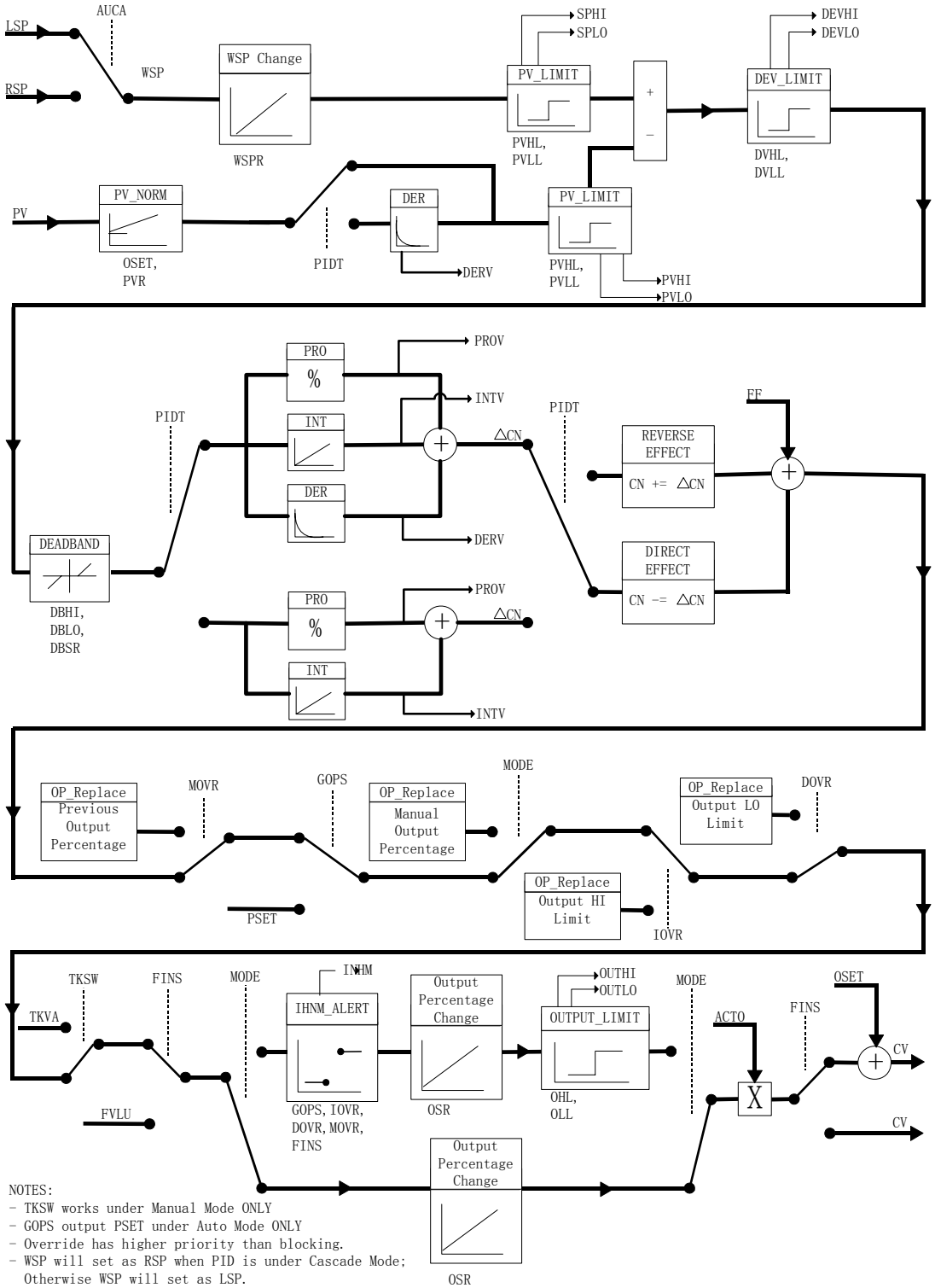
Figure 2 Derivative First PID Process

Formula of figure 2:

$$C_N = \frac{100}{P}(1+\frac{1}{T_I S})\{SP - \frac{1+T_D S}{1+\frac{1}{8}T_D S} PV\}$$

Note: C_N is the PID output, P is the Ratio, T_I is the Integral constant.
T_D is the Derivative constant, SP is the Set Point, PV is the Process Value.

2.1.2 Operation Graph



NOTES:
- TKSW works under Manual Mode ONLY
- GOPS output PSET under Auto Mode ONLY
- Override has higher priority than blocking.
- WSP will set as RSP when PID is under Cascade Mode; Otherwise WSP will set as LSP.
- PIDT: 0: Normal PID with direct effect;
  1: Normal PID with reverse effect;
  2: Derivative Go First PID with direct effect;
  3: Derivative Go First PID with reverse effect
- CN: PID output; CV: PID module output

Figure 3 PID Operation Graph

2.1.3 Parameters

PID Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
PV	REAL	Process Value This is a PID process value input.
RSP	REAL	Remote Set Point Working Set Point (WSP) will set as this RSP when the function block is under Cascade mode.
FF	REAL	Feed Forward It is a disturbed variable. It will be added to the PID output. Default: 0.0
TKVA	REAL	Tracking Value Output value will set as this Tracking Value when Tracking Switch (TKSW) is TRUE. Default: 0.0
TKSW	BOOL	Tracking Switch 0: Continue its process [Default] 1: Switch PID function block operation mode to Manual and output will track with Tracking Value (TKVA). Note: Could force the function block to switch to Manual Mode.
AUCA	BOOL	Auto / CASCADE switch 0: No Cascade Mode 1: Cascade Mode Note: Cascade could only work with Auto Mode. If the function block operation mode is under Manual mode, then it will not switch to Cascade mode.
GOPS	BOOL	Go Preset Switch This function works under Auto mode ONLY. 0: No Preset 1: Set output as Pre-Set value (PSET) Note: Active under Auto mode ONLY.
LOGI	DINT	Common Logic Input PID has 13 conditional inputs as Common Logic Inputs Please check the following LOGI Definition table.
FRBK	DINT	Force Back Address Input Receive the Force Back address “FBA” from the next level’s controller. Empty this field as Disable.

Table 2 PID Pin Input Parameters

LOGI Definitions

Definition	Description
XF	Exchange Failure
ABLK	Auto Mode Blocking
IBLK	Increment Blocking
DBLK	Decrement Blocking
IOVR	Increment Override
DOVR	Decrement Override
MOVR	Manual Mode Override
ROVR	Speed Rate Override
PCAN	Cancel Participation
ILMT	Reach Increment Limit
DLMT	Reach Decrement Limit
ASUS	Auto Suspension
LOCO	Local Controlling
ACK	Alarm Acknowledge
MODE	LSDP Mode

Table 3 LOGI Definitions

PID Pin Output Parameters

Name	Data Type	Description
CV	REAL	PID Control Value Output
LOGO	DINT	Common Logic Status Output This is a 32-bits output that shows the logic status.
AMW	DINT	Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions table below for details.
FBA	DINT	Force Back Address FBA output the current function block Force Back address to the Force Back controlling target and it should connect to the “FRBK” field.
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 4 PID Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
1	SPLO	WSP has been smaller than PV LO limit.
2	SPHI	WSP has been greater than PV HI limit.
3	DEVLO	Derivative LO Alert.
4	DEVHI	Derivative HI Alert.
5	PVLO	Process Variable LO Alert.
6	PVHI	Process Variable HI Alert.
7	OUTLO	CV has reached the LO Limit.
8	OUTHI	CV has reached the HI Limit.

9	GO_PRESET	Go Preset Switch is TRUE.
10	FORCEBACK	Restricted by the lower level ForceBack.
11	LOOPMANUAL	Return to Manual Mode with tracking TKVA.
12	ERRAOB	AOB Module Error.
13	INHM	Under Restricted, including ForceBack Restricted, Speed Rate Restricted, Upper and Lower Bounce Restricted.
14	CASCADE	Cascade Mode
15	AUTO	Auto Mode
16	MANUAL	Manual Mode

Table 5 AMW Definitions

LOGO Definitions

Bit Position	Definition	Description
1	ALARM	Alarm
2	XF	Exchange Failure
3	IRLS	Increment Release (Increment Allowed)
4	DRLS	Decrement Release (Decrement Allowed)
5	FBF	Feed Back Failure
6	IOVRD	Increment Override
7	DOVRD	Decrement Override
8	PCAN	Cancel Participation
9	ARLS	Auto Mode Release (Auto Allowed)
10	DUF	Drive Unit Failure
11	ALOSS	Auto Mode Loss
12	ATRPD	Auto Mode Trapped
13	ILMT	Reach Increment Limit
14	DLMT	Reach Decrement Limit
15	AINH	Auto Inhibit
16	AUTO	Auto Mode
17	LOCAL	Local Controlling
18	PATF	Participation Froze
19	REBAL	Rebalance
20	XCSCO	Cutout Exceeds Limits
31	ACK	Acknowledge (Alarm Cancellation)
32	MODE	LSDP Method

Table 6 LOGO Definitions

PID Internal Parameters & Force Back

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter needs to access this function block. Default: 6
WSP [REFERENCE ONLY]	REAL	Working Set Point Store either LSP or RSP as the final set point for PID process.

MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (STYP) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, ST could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO = Output Percentage*ACTO
PIDT	DINT	PID Type Choose the PID calculation methods: 0: Normal PID with Direct effect 1: Normal PID with Reversed effect 2: Differential Go First PID with Direct effect 3: Differential Go First PID with Reversed effect Default: 1
PVOS	REAL	PV Offset Adjust the Process Value starting point by giving it an offset. Default: 0.0
PVR	REAL	PV Ratio Adjust the ratio of PV by giving it a factor. Default: 1.0
LSP	REAL	Local Set Point Working Set Point (WSP) will set as this LSP when the function block is under Auto and Manual mode. When PID function block is under LSP Tracking, user will lose the priority on setting LSP value. Default: 0.0 (Have to set by operator)
LSPT	BOOL	Local Set Point Tracking When LSP Tracking is TRUE in Manual mode, LSP value will track with PV value and user will lose the priority on setting the LSP value. 0: No LSP Tracking 1: LSP Tracking [Default] Note: LSPT active under Manual Mode ONLY.
PVTK	BOOL	PV Tracking Set the Working Set Point (WSP) as PV value when PVTK is TRUE. 0: No PV Tracking 1: PV Tracking [Default] Note: PVTK active under Manual Mode ONLY. When the module switch back to Auto Mode and WSPR (Setting Point Change Rate) is not ZERO, the WSP will be set back to LSP respecting to WSPR.

PRAT	REAL	Proportional Constant This is a Proportional Bandwidth. When input value is 100%, the actual increment rate is 1.0 When input value is 200%, the actual increment rate is 0.5 When input value is 50%, the actual increment rate is 2.0 Unit is % Default: 240.0
ITIM	REAL	Integral Time Unit is minute e.g. 0.0 (No Integral Effect) Default: 4.5 minute
DTIM	REAL	Differential Time Unit is second Default: 0.0 (No Differential Effect)
DBHL	REAL	Dead Band HI Limit Set the Dead Band High limit Default: 0.5
DBLL	REAL	Dead Band LO Limit Set the Dead Band Low limit Default: -0.5
DBSR	REAL	Dead Band Slope Rate When the Error is within Dead Band, the current increase/decrease value will multiply (1-DBSR). DBSR range is between 0 ~ 1. e.g. DBSR=0.0 (means no Dead Band) DBSR=1.0 (means under Dead Band control and no adjustment needs to be made) Default: 1.0
WSPR	REAL	WSP Speed Rate WSPR is controlling the WSP change rate. If the current WSP value has been changed, then WSP value needs to be updated according to this WSPR, instead of updating the WSP value immediately. Default: 1.0 Note: Negative number will not affect on the WSP updates.
PVHR	REAL	PV HI Range Limit PVHR could have the same value as PV HI Limit (PVHL). Usually PVHR should be higher than the Output HI Limit because the limit should be inside the processing range Default: 100.0
PVLR	REAL	PV LO Range Limit PVLR could have the same value as PV LO Limit (PVLL), Usually PVLR should be lower than the Output LO Limit because the limit should be inside the processing range Default: 0.0
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. CV = Output Percentage * ACTO + OSET Default: 100.0

OSET	REAL	PID Output Offset This offset value gives user a chance to adjust project output range. e.g. if the project output range does not always start with ZERO, then user could use OSET to adjust the offset. CV = Output Percentage * ACTO + OSET Warning: OSET will not add to the CV when it receives any kind of Force Back from the lower level function block. Default: 0.0
PSET	REAL	Preset Value When the function block is under Auto or Cascade mode and GOPS is TURE, output will set as PSET. Default: 0.0
PVHL	REAL	PV HI Limit Avoid the PV or WSP to exceed the HI Limit. When PV or WSP has reached this limit, it will trigger PVHI or SPHI alarm in AMW. Default: 100.0
PVLL	REAL	PV LO Limit Avoid the PV or WSP to exceed the LO Limit. When PV or WSP has reached this limit, it will trigger PVLO or SPLO alarm in AMW. Default: 0.0
DVHL	REAL	Deviation HI Limit Deviation value (Error) is the comparison result between WSP and PV. Avoid Error to exceed the HI Limit. When Error has reached this DVHL, it will trigger DVHI alarm in AMW. Default: 100.0
DVLL	REAL	Deviation LO Limit Deviation value (Error) is the comparison result between WSP and PV. Avoid Error to exceed the LO Limit. When Error has reached this DVHL, it will trigger DVHI alarm in AMW. Default: -100.0
OHL	REAL	Output HI limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OHL, it will trigger OUTHI alarm in AMW. Default: 1.0
OLL	REAL	Output LO limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OLL, it will trigger OUTLO alarm in AMW. Default: 0.0
OSR	REAL	Output Speed Rate OSR is controlling the output change rate. If the output value has been updated, then output value needs to be changed according to this OSR, instead of updating the output value immediately. Unit is % per second; Default: 1.0 (100% per second)
PROV (N/A)	REAL	Proportional Value This is the proportional value of PID before it adds with Integral and Derivative values.

INTV (N/A)	REAL	Integral Value This is the integral output value of PID before it adds with Proportional and Integral values
DERV (N/A)	REAL	Derivative Value This is the derivative output value of PID before it adds with Proportional and Integral values.
FINS (REFERENCE ONLY)	DINT	Force Back Instance A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output A variable that shows the type of Force Back sending. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (N/A)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit.
FDEC (N/A)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out). It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage.
RSV2	DINT	32 bits reserved Force Back parameter for later usage.

Table 7 PID Internal Parameters and Force Back

2.1.4 Description

2.1.4.1. Set PID Type (PIDT)

The current function block has four kinds of PID calculation methods:
When PID Type (PIDT) is 0, the Normal PID with direct effect is selected.
When PID Type (PIDT) is 1, the Normal PID with reverse effect is selected.
When PID Type (PIDT) is 2, the Differential Go First PID with direct effect is selected.
When PID Type (PIDT) is 3, the Differential Go First PID with reverse effect is selected.

Note:

1) Direct Effect means: Previous PID output subtracts the current cycle PID output.
E.g. CN = CN - ΔCN

2) Reverse Effect means: Current cycle PID output adds to the previous PID output.
E.g. CN = CN + ΔCN

2.1.4.2. Initialization (First Run)

Under the Function Block FIRST RUN situation, if the Starting Type (ST) is FALSE, then the first cycle output value will be set as the Manual Starting Value (MSV).

When ST is TRUE, then the first cycle output value will be set as the last output value. If the current starting is a brand new starting, when ST is TRUE, the FIRST RUN output value will be ZERO.

2.1.4.3. Select Manual or Automatic or Cascade Mode

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (CV) will be set as the product of the Manual Output Percentage (MOP) and the Actual Project Output Range (ACTO), e.g. CV = MOP * ACTO. The user has the full control on the output by adjusting MOP when it has not received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode) and the Auto / Cascade Switch (AUCA) is FALSE (Auto mode), the Working Set Point (WSP) will be set as the Local Set Point (LSP). PV will be compared with LSP to get the Error value. Under the situation where Force Back control is not received and there are no kinds of restrictions (Exceed Output HI / LO Range, no Common Logic Input, and no Tracking Switch etc); CV will trace WSP according to the selected formula.

When Function Block Operation Mode (MODE) is TRUE (Auto mode) and the Auto / Cascade Switch (AUCA) is TRUE (Cascade mode), the Working Set Point (WSP) will be set as the Remote Set Point (RSP). The Process Value (PV) will be compared with RSP to get the Error value. Under the situation where Force Back control is not received and there are no kinds of restrictions (Exceed Output HI / LO Range, no Common Logic Input, and no Tracking Switch etc); CV will trace RSP according to the selected formula.

Note:

1) When the MODE has switched from Auto to Manual mode, CV will be retained as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode CV has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.
3) Cascade mode CANNOT be operating under Manual mode.

2.1.4.4. Set Working Set Point (WSP)

The Error is equal to the WSP minus the Process Value (PV). When the function block is either in Manual or Auto mode, WSP will be set as the Local Set Point (LSP) value. When the function block is in Cascade mode, WSP will be set as the Remote Set Point (RSP).

When the function block is tracking with LSP (LSPT is True) in Manual mode, WSP will be set as the Process Value (PV). At the same time, user will lose the authority on setting the LSP value.

When the function block is tracking with PV (PVTK is True) in Manual mode, WSP will be set as PV. When the MODE is set back to Auto mode, WSP value should track LSP according to the Working Set Point Speed Rate (WSPR), instead of updating immediately. (LSP should remain at the same value as before PVTK is set unless the user has updated LSP during PVTK period).

For instance:

+ Manual: !LSPT && ! PVTK → WSP = LSP
LSPT → WSP = LSP = PV
PVTK → WSP = PV

+ Auto: LSPT and PVTK (Not Active)
WSP = LSP (with respect to WSPR limit)

+ Cascade: LSPT and PVTK (Not Active)
WSP = RSP (with respect to WSPR limit)

+ Received Numerical Force Back:
WSP = PV (in both Auto and Cascade mode)

2.1.4.5. Local Set Point Tracking PV (LSPT) Mode

LSPT works in Manual mode only. When the Local Set Point Tracking (LSPT) is TRUE, both the Local Set Point (LSP) and the Working Set Point (WSP) should be set as the current Process Value (PV). At the same time user will lose the authority on setting the LSP value.

After a MODE switch from Manual to Auto mode, if LSP value has been changed, the WSP value should track LSP according to the Working Set Point Speed Rate (WSPR), instead of updating immediately.

2.1.4.6. Process Value Tracking (PVTK) Mode

PVTK works in Manual mode only. When the Process Value Tracking (PVTK) is TRUE, WSP should be set as the current Process Value (PV). LSP should remain at the same value unless the user has updated LSP during PVTK period.

After the MODE has switched from Manual to Auto mode, WSP should track LSP according to the Working Set Point Speed Rate (WSPR), instead of updating immediately.

2.1.4.7. Set WSP Speed Rate (WSPR)

When the Working Set Point (WSP) has updated in Auto mode, WSP should be updated according to WSPR. WSP's update should not be done immediately, unless WSPD equals Zero.

2.1.4.8. Set Dead Band on Deviation

When the Deviation or Error (EN) is within the Dead Band Range, between Dead Band Hi Limit (DBHL) and Dead Band Lo Limit (DBLL), EN will multiply by "1-DBSR". The DBSR input range should between 0 ~ 1. For instance, DBSR could be 0.0, 0.25, 0.5, 1.0 etc. When DBSR is "0.0", it means the Dead Band does not take place. When DBSR is "1.0", the Dead Band will take effect.

2.1.4.9. Go Pre-Set Mode (GOPS)

The Go Preset Switch (GOPS) only activates in Auto mode. When it is set to TRUE, the output (CV) will track with Preset Value (PSET). GOPS is different than the Tracking Switch (TKSW) mode because TKSW activates in both Manual and Auto mode.

2.1.4.10. Set Tracking Switch Mode (TKSW)

When Tracking Switch is set to TRUE, the Function Block Operation Mode (MODE) will switch to Manual and the PID control output (CV) will track with the Tracking Value (TKVA). The TKSW mode activates in all Manual, Auto and Cascade modes.

2.1.4.11. Set PID Force Back

The PID function block could receive both Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit). However, the PID has No Force Back Enable (FEN) control on sending Numerical Force Back in Manual, Auto and Cascade modes. Please read the following conditions for details:

Manual Mode:

1) No Force Back Enable (FEN)
2) Automatically set Force Back Value for Numerical Force Back

Auto Mode:

1) No Force Back Enable (FEN)
2) Automatically set Force Back Value for Numerical Force Back, including operating in IOVR, DOVR, GORS or MOVR mode.
3) Able to Receive and Send out Numerical Force Back

Cascade Mode:

1) No Force Back Enable (FEN)
2) Able to Receive and Send out Numerical Force Back
3) IOVR, DOVR, GORS or MOVR mode, Automatically set Force Back Value for Numerical Force Back

The following details define the Numerical Force Back and the Restricted Force Back in the PID function block:

1) Numerical Force Back (Value Tracking):
   - When the Numerical Force Back is activated, the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0
2) Restricted Force Back (Set Limit):
   - When the PID function block receives the Restricted Force Back from the lower level module, the PID will set the received value to its Output HI or LO Limit (OHL / OLL).
   - Not able to send out Restricted Force Back.
3) Special Condition in Force Back (For connecting the “Switch” as lower level):
   - The switch takes two input values (PV1 & PV2), “Selected” and “Stand-by”. When the selected module receives Force Back Control from the “Switch”, the stand-by module should automatically receive Numerical Force Back at the same time from the “Switch” in Auto mode.
4) Warning:
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - By receiving the Force Back control from the lower level module, the current function block does not have priority to reject the order.

2.1.4.12. Common Logic Input & Output

The Common Logic Input (LOGI) has 13 input fields:
Exchange Failure (**XF**), Auto Mode Blocking (**ABLK**), Increment Blocking (**IBLK**), Decrement Blocking (**DBLK**), Increment Override (**IOVR**), Decrement Override (**DOVR**), Manual Mode Override (**MOVR**), Speed Rate Override (**ROVR**), Cancel Participation (**PCAN**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Suspend (**ASUS**), Local Controlling (**LOCO**)

The Common Logic Output (LOGO) has 22 output fields:
Alarm (**ALARM**), Exchange Failure (**XF**), Increment Release (**IRLS**), Decrement Release (**DRLS**), Feed Back Failure (**FBF**), Increment Override (**IOVRD**), Decrement Override (**DOVRD**), Cancel Participation (**PCAN**), Automatic Release (**ARLS**), Drive Unit Failure (**DUF**), Auto Loss (**ALOSS**), Auto Trapped (**ATRPD**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Inhibit (**AINH**), Auto

Mode (**AUTO**), Local Controlling (**LOCAL**), Partition Froze (**PATF**), Rebalance (**RBAL**), Cutout Exceeds Limit (**XCSCO**), Acknowledge (**ACK**), LSDP Method (**MODE**)

Note:
Please see CLogic specification for more details.

2.1.4.13. Common Logic Input – Manual Override (MOVR)

Manual Override (MOVR) will take effect under conditions from Common Logic Inputs, i.e. when both Increase Override (IOVR in Common Logic Input) and Decrease Override (DOVR in Common Logic Input) are TRUE, manual override is also TRUE. Once MOVR is set, the Output (CV) will be locked at.the current value.

Please consider the following situations that MOVR will not take control in the PID:
1) The PID is in Manual mode, Function Block Operation Mode (MODE) is FALSE.
2) The PID is in Tracking Value mode (Tracking Switch, TKSW, is TRUE)
3) The PID is in Go Preset mode (Go Preset Switch, GOPS, is TRUE)

2.1.4.14. Common Logic Input – Increase & Decrease Override (IOVR & DOVR)

Increase Override (IOVR) works in Manual, Auto and Cascade modes. When IOVR is TRUE, the Output (CV) will track with the Output HI Limit (OHL).
Decrease Override (DOVR) works in Manual, Auto and Cascade modes. When DOVR is TRUE, CV will track with the Output LO Limit (OLL).

Special Cases:
1) When both IOVR and DOVR are TRUE in Manual mode, DOVR should have higher priority than IOVR.
2) When both IOVR and DOVR are set in Auto mode, MOVR would be set and the current CV would remain at the pervious output value.

2.1.4.15. Common Logic Input – Speed Rate Override (ROVR)

Speed Rate Override is one of the Common Logic Inputs. When ROVR is set to TRUE, it will disable the function of Output Speed Rate (OSR). The function block would not have rate restriction from OSR.

Please consider the following situations when ROVR might or might not function in PID:
1) ROVR might work in any type of the PID calculation methods.
2) ROVR might work in Tracking Value mode (Tracking Switch, TKSW is TRUE).
3) ROVR might work in Go Preset mode (Go Preset Switch, GOPS, is TRUE).
4) ROVR might work in CV value is changing in Increase or Decrease Override (IOVR or DOVR is TRUE).

2.1.4.16. Common Logic Input – Auto Suspend (ASUS)

ASUS authorizes the module to remain in auto mode operation in case of loss of Auto mode control.

For instance:
When PID receives only XF from Common Logic module, PID should operate in Manual mode and its Common Logic Status Output (LOGO) should have Alarm, XF, ALOSS, ATRAP. If PID receives only XF and ASUS from Common Logic module, PID should maintain in auto mode operation and its LOGO should have Alarm, XF and ALOSS only.

Note:

AMW should show the user that the module is still operating under auto mode, but LOGO should not be displayed.

2.1.4.17. Force Back Control Related Modules

The list below shows all modules that have the Force Back Control function:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.2 CLogic

The “CLogic” function block mainly provides an encoding operation to compress all Boolean type inputs into one DINT type output. CLogic should only support controlling function blocks like PID. Check the LOGI Definitions Table below or the controlling function block for more details.

2.2.1 Parameters

Calling Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
XF	BOOL	Exchange Failure 0: Exchanger is OK [Default] 1: Exchange Failure occurs
ABLK	BOOL	Auto Restricted 0: Auto Mode is OK [Default] 1: Auto Mode disable
IBLK	BOOL	Increase Blocking 0: No Increment Blocking [Default] 1: Increment Blocking is activated
DBLK	BOOL	Decrease Blocking 0: No Decrement Blocking [Default] 1: Decrement Blocking is activated
IOVR	BOOL	Increase Override 0: No Increment Override [Default] 1: Increment Override is activated
DOVR	BOOL	Decrease Override 0: No Decrement Override [Default] 1: Decrement Override is activated
MOVR	BOOL	Manual Override The output will remain at the previous cycle output value when MOVR is TRUE under Auto Mode 0: No Manual Override [Default] 1: Manual Override is activated Note: MOVR will not take effect under Manual Mode.
ROVR	BOOL	Speed Rate Override The output will not follow the Output Speed Rate (OSR) for output value change when ROVR is TRUE, except the output is using any PID calculation method. 0: No Speed Rate Override [Default] 1: Speed Rate Override is activated
PCAN	BOOL	Participation Cancellation 0: No Participation Cancellation [Default] 1: Participation Cancellation is activated
ILMT	BOOL	Reached Increment Limit 0: PID output has NOT reached Increment Limit [Default] 1: Reach the Increment Limit

DLMT	BOOL	Reached Decrement Limit 0: PID output has NOT reached Decrement Limit [Default] 1: Reach the Decrement Limit
ASUS	BOOL	Auto Suspend 0: No Auto Suspend 1: Auto Suspend is activated
LOCO	BOOL	Local Controlling 0: Do NOT have the local controlling [Default] 1: Local Controlling is activated
ACK	BOOL	Alarm Acknowledge Reset Alarm in Common Logic Output. 0: Do NOT reset the Alarm [Default] 1: Reset the Alarm in Common Logic Output Note: Function block takes action only when ACK pulse from "0" to "1". If this input maintains at the status "1", function block will not recognize the command.
MMOD	BOOL	LSDP Mode 0: Operates normally 1: Set Alarm Note: MMOD is same as MODE in Common Logic Output

Table 8 Calling Parameters

Return Parameters

Name	Data Type	Description
AO	DINT	It will output a compacted 32-bit status variable, LOGO. Check the following LOGO definition table for details.

Table 9 Return Parameters

"LOGO" Definitions

Bit Position	Definition	Description
1	ALARM	Alarm
2	XF	Exchange Failure
3	IRLS	Increment Release (Allow Increment)
4	DRLS	Decrement Release (Allow Decrement)
5	FBF	Feed Back Failure
6	IOVRD	Increment Override
7	DOVRD	Decrement Override
8	PCAN	Cancel Participation
9	ARLS	Automatic Release (Allow Auto)
10	DUF	Machine Executing Failure
11	ALOSS	Automatically Loss
12	ATRPD	Automatically Trapped
13	ILMT	Reach Increment Limit
14	DLMT	Reach Decrement Limit
15	AINH	Automatically Restricted
16	AUTO	Automatic
17	LOCAL	Local Controlling

18	PATF	PAT Froze
19	RBAL	Rebalance
20	NFBL	No Feedback Limit
31	ACK	Acknowledge (Alarm Cancellation)
32	MODE	LSDP Method

Table 10 LOGO Definitions

2.2.2 Description

2.2.2.1. Common Logic Input – Increase & Decrease Override (IOVR & DOVR)

Increase Override (IOVR) works in Manual and Auto mode (including Cascade mode). When IOVR is TRUE, the Output (CV) will track with the Output HI Limit (OHL).
Decrease Override (DOVR) works in Manual and Auto modes (including Cascade mode). When DOVR is TRUE, CV will track with the Output LO Limit (OLL).

Special Cases:

1) When both IOVR and DOVR are TRUE in Manual mode, DOVR should have higher priority than IOVR.
2) When both IOVR and DOVR are set, MOVR would be set and the current CV would remain at the pervious output value.

2.2.2.2. Set Manual Override (MOVR)

Manual Override (MOVR) can be set from the Common Logic Input, i.e. when both the Increase Override (IOVR in Common Logic Input) and Decrease Override (DOVR in Common Logic Input) are TRUE, the MOVR will be set to TRUE. Once MOVR is set, the Output (CV) will be locked at the current value.

Please consider the following situations that MOVR will not take control:

1) In Manual mode, Function Block Operation Mode (MODE) is FALSE.
2) In Tracking Value mode (Tracking Switch, TKSW, is TRUE)
3) In Go Preset mode (Go Preset Switch, GOPS, is TRUE)

2.2.2.3. Set Speed Rate Override (ROVR)

Speed Rate Override is one of the Common Logic Inputs. When ROVR is set to TRUE, it will disable the function of Output Speed Rate (OSR). The function block would not have rate restriction from OSR.

Please consider the following situations when ROVR might or might not function:

1) ROVR might work in any type of the PID calculation methods.
2) ROVR might work in Tracking Value mode (Tracking Switch, TKSW is TRUE).
3) ROVR might work in Go Preset mode (Go Preset Switch, GOPS, is TRUE).
4) ROVR might work in CV value is changing in Increase or Decrease Override (IOVR or DOVR is TRUE).

2.2.2.4. Common Logic Input – Auto Suspend (ASUS)

ASUS authorizes the module to remain in auto mode operation in case of loss of Auto mode control.

For instance:
When PID received only XF from Common Logic module, PID should operate in Manual mode and its Common Logic Status Output (LOGO) should have Alarm, XF, ALOSS, ATRAP. If PID received only XF and ASUS from Common Logic module, PID should maintain in auto mode operation and its LOGO should have Alarm, XF and ALOSS only.

Note: AMW should show user that module is still operating under auto mode, but LOGO should not show.

2.2.2.5. Common Logic Output – Alarm Cancellation

The Alarm parameter is one of the Common Logic Outputs. When Alarm is set to TRUE, one of the options for cancellation is using CiCode or alternatively is to manually set the ACK (one of the Common Logic Outputs) for Alarm Cancellation.

Note:

1) Ensure ACK is reset to Zero after each Alarm Cancellation; otherwise the ACK will not take action for the next cancellation.
2) Ensure all the errors have been fixed before using the ACK for Alarm Cancellation.

2.2.2.6. General Example of Connecting CLogic to DEB400

The CLogic function block provides some common inputs to PID, Switch, Participation, and DEB400 function blocks. The following diagram shows how to connect CLogic to DEB400:

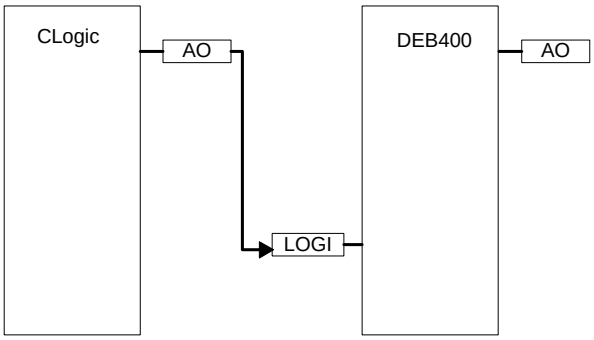


Figure 4 Settings of Using DEB400 with CLogic

Note:

Output Connections: CLogic output is connected to DEB400 Common Logic Input (LOGI)

2.2.2.7. Hints, Tips, and Frequently Asked Questions

Q: What is the consequence of giving an ACK (Alarm Acknowledge) before the problem is solved? e.g. A module receives a common logic XF, but the operator gave an ACK before the XF problem is fixed.

A: ALARM should be set when the connected function block is under the condition of AUTO (Common Logic Output), not will in Auto Suspend or ATRPD. Since the connected function block should shift to Manual mode once when under the condition of ATRPD, therefore ALARM can not be set after an improper alarm acknowledge.

2.3 Servo

This “Servo” function block mainly provides output speed rate controlling on Force Back Tracking, PV Tracking, Increase Override and Decrease Override. This function block also provides output HOLD, Increase Blocking and Decrease Blocking over Increase Override and Decrease Override. There has no Force Back Return to the upper level when the HOLD, Increase Blocking or Decrease Blocking is TRUE.

2.3.1 Parameters

Servo Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
PV	REAL	Process Value Default: 0.0
STDR	REAL	Standard Speed Rate This is the selected speed rate when “Rate Selection” (RSEL) is TRUE. Default: 0.0 Note: If both Conditional Speed Rate (CONS) and Standard Speed Rate (STDR) have the same value, the changing result of using STDR should 100 times smaller than the other.
RSEL	BOOL	Rate Selection 0: Select the Conditional Speed Rate (CONS) from parameter. [Default] 1: Select the Standard Speed Rate (STDR) from input pin. Note: When either CONS or STDR is used, it will replace the Output Speed Rate (OSR)
HOLD	BOOL	Hold the current values 0: Continue process with the current setting. [Default] 1: Retains at the pervious output Note: HOLD, IBLK, and DBLK have higher priority than IOVD and DOVD.
IBLK	BOOL	Increase Blocking 0: Allow output increment [Default] 1: Not Allow output increment Note: 1) HOLD, IBLK, and DBLK have higher priority than IOVD and DOVD.

		2) IBLK has higher priority than DBLK
DBLK	BOOL	Decrease Blocking 0: Allow output decrement [Default] 1: Not allow output decrement Note: 1) HOLD, IBLK, and DBLK have higher priority than IOVD and DOVD. 2) IBLK has higher priority than DBLK
IOVR	BOOL	Increase Override 0: Remains the current output speed rate (OSR) [Default] 1: Override the current output speed rate with RSEL selected rate when the output is increasing. Note: 1) When HOLD, IBLK or DBLK is TRUE, IOVD will be disabled. 2) IOVR has higher priority than DOVR
DOVR	BOOL	Decrease Override 0: Remains the current output speed rate (OSR) [Default] 1: Override the current output speed rate with RSEL selected rate when the output is decreasing. Note: 1) When HOLD, IBLK or DBLK is TRUE, DOVD will be disabled. 2) IOVR has higher priority than DOVR
TKPV	BOOL	Tracking PV 0: Continue with the current process [Default] 1: Output tracks with PV e.g. AO = PVR* PV
FRBK	DINT	Force Back Address Input Receiving the Force Back address “FBA” from the next lower level module. Note: 1) Function Block has no priority to refuse Force Back acceptance. 2) Servo Force Block controlling is different than other function blocks, please refer to “Set Force Black Enable” in “Function Block Calling” for more details.

Table 11 Servo Pin Input Parameters

Servo Pin Output Parameters

Name	Data Type	Description
AO	REAL	Output with selected Speed Rate
AMW	DINT	Auto Mode Warning It is a 32-bit alert that notice user something wrong either on the input or the output.
FBA	DINT	Force Back Address Servo has one address output. This address output for Force Back values access purpose. Pass it to the upper level “FRBK” field.
IA	DINT	Instance Address The output is the location of the current module’s address. e.g. It could be output to Reader or Writer Module for PID Instance’s access.

Table 12 Servo Pin Output Parameters

AWM Definitions

Bit Position	Definition	Description
1	HOLD	Retain the previous cycle Output
2	IBLK	Output is Increase Blocking
3	DBLK	Output is Decrease Blocking
4	OUTINC	Output is increasing
5	OUTDEC	Output is decreasing
7	OUTLO	Output has reached the Output LO Limit
8	OUTHI	Output has reached the Output HI Limit
10	FORCEBACK	Received Force Back from the lower level module
13	INHM	Restricted, including: FORCEBACK Restriction, Speed Limit, Upper and lower bounce restriction
14	FBACKERR	Invalid input value for getting the proper force back value. Hints: PVR should not be equal to ZERO.
15	AUTO	Function Block is under Auto Mode
16	MANUAL	Function Block is under Manual Mode

Table 13 AWM Definitions

Server Internal Parameters

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90

FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter need to access this function block. Default: 5
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (STYP) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, ST could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO=Output Percentage*ACTO
FBMO	BOOL	Force Back Mode 0: Keep the current value of Force Back Output [Default] 1: Clear the increment and decrement blocking bits in Force Back Output
PVR	REAL	PV Ratio. User could give the PV input a ratio. Default: 1.0
CONS	REAL	Conditional Speed Rate This is the selected speed rate output when “Rate Selection” (RSEL) is FALSE. Unit is % per second; Default: 0.10 (10% per second) Note: If CONS is set as the same value as OSR, then CONS will remain the same operation as OSR.
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = Output Percentage * ACTO Default: 100.0
OHL	REAL	Output HI Limit Gives output value a high limit to confirm the output value is under the high limit safe range. When the Output has reached the HI limit, it will trigger OUTHI in AMW Default: 1.0
OLL	REAL	Output LO Limit Gives output value a low limit to confirm the output value is above the low limit safe range. When the Output has reached the LO limit, it will trigger OUTLO in AMW

		Default: 0.0
OSR	REAL	Output Speed Rate When the output value has been changed, it will change according to this OSR. Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: 1) Numerical Force Back (means Tracking) will switch ON when the module is under Manual Mode 2) Restricted Force Back (means Set Limit) will switch ON when the module is under Auto Mode 0: Disable the Force Back 1: Enable the Force Back [Default]
FINS (REFERENCE ONLY)	DINT	Force Back Instance A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output A variable that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV	REAL	Force Back Input Value (Receive)

(REFERENCE ONLY)		It is a Force Back Tracking value that receives from the lower level module
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage
RSV2	DINT	32 bits reserved Force Back parameter for later usage

Table 14 Servo Internal Parameters

2.3.2 Description

2.3.2.1. Initialization (FIRST RUN)

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value will set as the Manual Starting Value (MSV).

When STYP is TRUE, it will initialize the output value (AO) and the Numerical Force Back value. The first cycle output value (AO) and the Numerical Force Back value will be maintained as the last output value. If STYP set as TRUE at a brand new start, AO and all Force Back values should be initialized as ZERO.

2.3.2.2. Select Manual or Automatic Mode

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set equal to the Manual Output Percentage (MOP) of the Actual Project Output Range (ACTO). “e.g. AO = MOP * ACTO” The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) should be set as the function block result when there is no received Force Back control and no kinds of restrictions (like exceeding the Output HI / LO Range).

Note:

1) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.3.2.3. Set Actual Project Output Range (ACTO)

ACTO should set as the Maximum value of current project output range.

e.g. If the current project is controlling temperature, and the assumed range is between 0 ~ 100 degrees, then ACTO should set as 100.0.

2.3.2.4. Set Tracking PV (TKPV)

When TKPV is FALSE, continue the process with the current Servo setting.
When TKPV is TRUE, Output (AO) will track with the Process Value (PV) in Auto mode.
e.g. AO = PVR* PV

Note:
1) Servo function block accepts Force Back Increase / Decrease Blocking Value from lower level module while Servo is processing in Tracking PV mode.
2) Output Speed Rate (OSR) should be used when Servo is tracking PV. In the other words, both Standard Speed Rate (STDR) and Conditional Speed Rate (CONS) would not affect AO when Servo is in TKPV mode.

2.3.2.5. Set HOLD

When HOLD is FALSE, continue the process with the current Servo settings.
When HOLD is TRUE, Output (AO) retains the previous cycle output in Auto mode.

Note:
HOLD, IBLK, DBLK have higher priority than IOVR & DOVR and will not Force Back to the upper level.

2.3.2.6. Set Rate Selection

When RSEL is TRUE, the output rate will be set as the function block input pin, “STDR”, value.
When RSEL is FALSE, the output rate will be set as the internal parameter, “CONS”, value.

Both Conditional Rate (CONS) and Standard Speed Rate (STDR) are used when function block does not track with PV. On the other hand, the Output Speed Rate (OSR) is used when the function is tracking with PV. Therefore, any of these three speed rates would not overlap each other.

Note:
1) The rate change will not directly affect the output. It only affects either the Increase or Decrease Override process in Auto mode.
2) Output Speed Rate (OSR), Standard Speed Rate (STDR) and Conditional Speed Rate (CONS) will not apply in the same cycle.

2.3.2.7. Set Increase / Decrease Override (IOVR / DOVR)

When IOVR is TRUE, the output increment rate depends on the Rate Selection (RSEL).
When DOVR is TRUE, the output decrement rate depends on the Rate Selection (RSEL)

Note:
1) When Rate Selection (RSEL) is FALSE, Conditional Rate (CONS) is chosen.
2) When Rate Selection (RSEL) is TRUE, Standard Speed Rate (STDR) is chosen.
3) HOLD, IBLK, DBLK have higher priority than IOVR & DOVR and will not Force Back to the upper level.
4) IOVR has higher priority than DOVR when both IOVR and DOVR are set.

2.3.2.8. Set Increase / Decrease Blocking (IBLK / DBLK)

When IBLK is TRUE, it retains the previous cycle output if the current AO is increasing.
When DBLK is TRUE, it retains the previous cycle output if the current AO is decreasing.

Note:
1) If the current AO is increasing, DBLK will not take control.
2) If the current AO is decreasing, IBLK will not take control.

3) HOLD, IBLK, DBLK have higher priority than IOVR & DOVR and will not Force Back to the upper level.
4) IBLK has higher priority than DBLK when both IBLK and DBLK are set.

2.3.2.9. Set Force Back mode (FBMO)

When Force Back mode (FBMO) is set to TRUE, the Restricted Force Back signal at the Force Back Output (FOUT) will be cancelled.
0: Keep the current value of Force Back Output [Default]
1: Clear the increment and decrement blocking bits in Force Back Output

2.3.2.10. Set Servo Force Back

This function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit).

Servo **Manual mode** will not receive any Force Back control, but is able to set the Numerical Force Back when Force Back Enable (FEN) is set.

Servo **Auto mode** can accept and release both Numerical and Restricted Force Back control (*Receive Restricted Force Back control when Servo is in TKPV mode*). When both Force Back Enable (FEN) and Tracking PV (TKPV) are set to TRUE, Servo will send out Numerical Force Back control in Auto mode. When Force Back Enable (FEN) is set to TRUE and the current output has reached the Output HI / LO Limit (OHL / OLL), Servo will send out Restricted Force Back control in Auto mode.

1) Numerical Force Back (Value Tracking):
   - When Force Back Enable (FEN) is True under Manual Mode (MODE = False), the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0
2) Restricted Force Back (Set Limit):
   - When Force Back Enable (FEN is True under Auto Mode (MODE = True) and the current function block output has reached the Output HI Limit (OHL) or Output LO Limit (OLL), the current function block will calculate a Force Back Blocking value and enforce a connected upper level module OHL or OLL to follow.
   - When the current function block receives Restricted Force Back control from the lower level module, it will set the received value to its Output HI or LO Limit (OHL / OLL).
3) Special Condition in Force Back (For connecting “Switch” as lower level):
   - Switch takes two input values (PV1 & PV2), “Selected” and “Stand-by”. When the selected module receives Force Back Control from “Switch”, the stand-by module should automatically receive Numerical Force Back at the same time from “Switch” in Auto mode
4) Warning:
   - Under Numerical Force Back (Value Tracking), PV Ratio (PVR) cannot be Zero.
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - Numerical Force Back (Value Tracking) will not be set in Auto mode until both FEN and TKPV are TRUE.
   - Force Back Enable is only gives the current function block priority to choose between returning the Force Back control to the upper level or not. It is NOT giving the current function block authority to choose between accepting the Force Back control from the lower level or not.
   - Servo would ONLY receive Restricted Force Back when it operates with Tracking PV (TKPV) in Auto mode.

2.3.2.11. Force Back Control Related Modules

The list below details all modules that have the Force Back Control function:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.3.2.12. General Example of Using Servo with Switch and PID

Since Servo has some similar functions as in the Common Logic function block (CLogic) like HOLD, IBLK, DBLK, IOVR and DOVR, Servo could follow any non-CLogic input function block as in the following diagram:

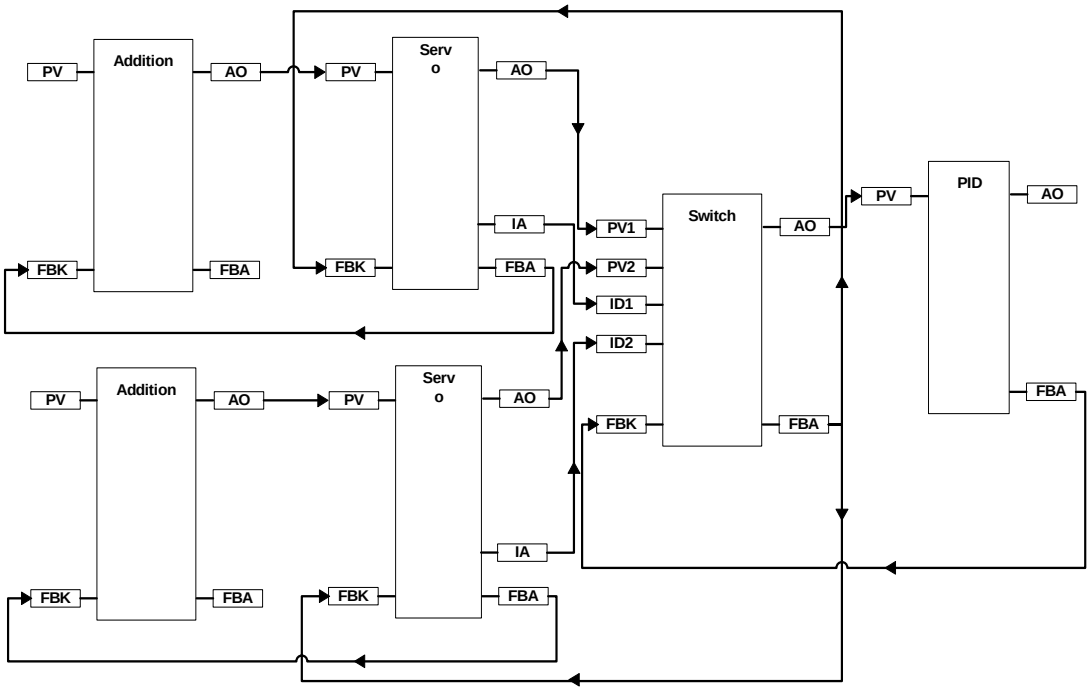


Figure 5 Settings for Using Addition -> Switch -> PID

Note:

1) Output Connections: Each Addition output is connected to a different Servo input (PV). Each Servo output is connected to a Switch input (PV1 and PV2). A Switch output is connected to a PID input (PV).
2) Instance Address Connections: Each Servo Instance Address Output (IA) is connected to a different Switch ID input (ID1 & ID2).
3) Force Back Connections: A PID force back address output is connected to a Switch force back address input. Switch force back address outputs are connected to both Servos' force back address inputs. Each Servo's force back address output is connected to the Addition force back address input that it had interaction with.

2.4 LeadLag

This “LeadLag” function block mainly provides the user with Lead and Lag functions. Users can directly set the Lead and Lag time. Besides the Lead and Lag functions, this module also provides three other functions as WASHOUT, FORCEBACK and INITIALIZATION.

2.4.1 Parameters

LeadLag Calling Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
PV	REAL	Process Value Default: 0.0
INI	BOOL	Initialization Initialize some internal variables. First Lag Time (LAG1) should disable when INI is set. 0: Disable / Default 1: Enable
RSV5	BOOL	8 bits reserved internal parameter for later usage
RSV6	REAL	32 bits reserved internal parameter for later usage
FRBK	DINT	Force Back Address Input Receiving the Force Back address “FBA” from the next lower level module. Note: Function Block has no priority to refuse Force Back acceptance.

Table 15 LeadLag Calling Pin Input Parameters

LeadLag Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output AO is the formula result.
AMW	DINT	Auto Mode Warning It is a 32-bit alert that notice user something wrong either on the input or the output when the module is under Auto Mode
FBA	DINT	Force Back Address FBA output the current function block Force Back address to the Force Back controlling target and it should connect to the controlling target “FRBK” field.
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 16 LeadLag Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
5	PVLO	PV has reached the Process Value LO Limit
6	PVHI	PV has reached the Process Value HI Limit
7	OUTLO	AO has reached the Output LO Limit (OLL)
8	OUTHI	AO has reached the Output HI Limit (OHL)
10	FORCEBACK	Received Force Back from lower level module
13	INHM	Restricted, including: FORCEBACK Restriction, Speed Limit, Upper and lower bounce restriction
14	FBACKERR	Invalid input value for getting the proper force back value. Hints: PVR should not be equal to ZERO.
15	AUTO	LeadLag Function Block is operating in Auto Mode
16	MANUAL	LeadLag Function Block is operating in Manual Mode

Table 17 AMW Definitions

LeadLag Calling Internal Parameters

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter need to access this function block. Default: 4
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (STYP) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, STYP could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO=Output Percentage*ACTO
PVR	REAL	PV Ratio. User could give the PV input a ratio. Default: 1.0 (Remain original PV input value)
LTIM	REAL	Lead Time Value User could set the Lead Time value. The unit counts by second. Default: 0.0
LAG1	REAL	First Lag Time Value User could set the First Lag Time value. The unit counts by second. Default: 25.0 (25 seconds) Note: 1 minute = 60.0 seconds
LAG2	REAL	Second Lag Time Value User could set the Second Lag Time value. The unit counts by second. Default: 0.0 Note: 1 minute = 60.0 seconds
OSET	REAL	PV Offset It gives users an opportunity to re-adjust the starting point of the PV to below zero or above zero. Default: 0.0
PVHL	REAL	PV HI Limit Avoid the PV to exceed the HI Limit. When PV has reached this limit, it will trigger PVHI alarm in AMW.

		Default: 100.0
PVLL	REAL	PV LO Limit Avoid the PV to exceed the LO Limit. When PV has reached this limit, it will trigger PVLO alarm in AMW. Default: 0.0
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range Default: 100.0 Note: AO = Output Percentage * ACTO
WASH	BOOL	Wash Out 0: Set x=0; AO would not track with PV value. 1: Set x=1; AO would track with PV value. Default: 1
RSV3	DINT	32 bits reserved internal parameter for later usage
RSV4	DINT	32 bits reserved internal parameter for later usage
OHL	REAL	Output HI Limit Gives output percentage (same as MOP in Auto Mode) a high limit to confirm the output value is under the high limit safe range. Default: 1.0
OLL	REAL	Output LO Limit Gives output percentage (same as MOP in Auto Mode) a low limit to confirm the output value is above the low limit safe range Default: 0.0
OSR	REAL	Output Speed Rate When the output value has been changed, it will change according to this OSR instead of updating the output value immediately. Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: 1) Numerical Force Back (Value Tracking) will switch ON when the module is under Manual Mode 2) Restricted Force Back (Set Limit) will switch ON when the module is under Auto Mode 0: Disable the Force Back 1: Enable the Force Back [Default]
FINS (REFERENCE ONLY)	DINT	Force Back Instance A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit)

		4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output A variable that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit.
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage.
RSV2	DINT	32 bits reserved Force Back parameter for later usage.

Table 18 LeadLag Calling Internal Parameters

2.4.2 Description

2.4.2.1. Initialization

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value will set as the Manual Starting Value (MSV).

When STYP is TRUE, it will initialize the output value (AO) and Numerical Force Back value. The first cycle output value (AO) and the Numerical Force Back value will be maintained as the last output value. If STYP set as TRUE at a brand new start, AO and all Force Back values should be initialized as ZERO.

2.4.2.2. Select Manual or Automatic Mode

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set to the product of the Manual Output Percentage (MOP) and the Actual Project Output Range (ACTO). “e.g. AO = MOP * ACTO” The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) will be set as the function block result when there is no received Force Back control and there are no kinds of restrictions (Exceed Output HI / LO Range).

Note:

1) When the MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When the MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.4.2.3. Wash Out Mode

Wash Out allows AO to track with PV and maintains at PV level.

When Wash Out (WASH) is TRUE, it will set the value of “x” in the formula to 1.
When Wash Out (WASH) is FALSE, it will set the value of “x” in the formula to 0.

2.4.2.4. Initialization Mode

It initializes some internal variables. First Lag Time (LAG1) should disable when INI is set.

2.4.2.5. Set Lead Lag Force Back

The LeadLag function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit).

LeadLag **Manual mode** will not receive any Force Back control, but is able to set the Numerical Force Back when Force Back Enable (FEN) is set.

LeadLag **Auto mode** accepts and releases both Numerical and Restricted Force Back control. If the PV Ratio (PVR) is not equal to Zero, LeadLag will set the Force Back Value for Numerical Force Back control on the upper level module. When Force Back Enable (FEN) is set to TRUE and the current output has reached the Output HI / LO Limit (OHL / OLL), LeadLag will send out Restricted Force Back control in Auto mode.

1) Numerical Force Back (Value Tracking):
   - When Force Back Enable (FEN) is True under Manual Mode (MODE = False), the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0

2) Restricted Force Back (Set Limit):
   - When Force Back Enable (FEN is True under Auto Mode (MODE = True) and the current function block output has reached the Output HI Limit (OHL) or Output LO Limit (OLL), the current function block will calculate a Force Back Blocking value and enforce a connected upper level module OHL or OLL to follow.
   - When LeadLag function block received Restricted Force Back control from lower level module, LeadLag will set the received value to its Output HI or LO Limit (OHL / OLL).

3) Special Condition in Force Back (For connecting “Switch” as lower level):
   - Switch takes two input values (PV1 & PV2), “Selected” and “Stand-by”. When the selected module receives Force Back Control from “Switch”, the stand-by module should automatically receive Numerical Force Back at the same time from “Switch” in Auto mode.

4) Warning:
   - Under Numerical Force Back (Value Tracking), PV Ratio (PVR) cannot be Zero.
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - Numerical Force Back (Value Tracking) will not be set in Auto mode till FEN is set to TRUE.
   - Force Back Enable only gives the current function block priority to choose between returning the Force Back control to the upper level or not. It is NOT giving the current function block authority to choose between accepting the Force Back control from the lower level or not.

2.5 Addition

This “Addition” function block provides an addition function for a maximum of four numeric inputs each with a corresponding input’s percentage. This function also provides a Force Back input option.

2.5.1 Operation Formula

$$AO = (INR1*IN1)+(INR2*IN2)+(INR3*IN3)+(INR4*IN4)+OSET$$

Note: AO = Output
INR1 = Input Rate for First Input Value
IN1 = First Input Value
INR2 = Input Rate for Second Input Value
IN2 = Second Input Value
INR3 = Input Rate for Third Input Value
IN3 = Third Input Value
INR4 = Input Rate for Fourth Input Value
IN4 = Fourth Input Value
OSET = Formula Offset

2.5.2 Parameters

Addition Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
IN1	REAL	First Numerical Input Default: 0.0
IN2	REAL	Second Numerical Input Default: 0.0
IN3	REAL	Third Numerical Input Default: 0.0
IN4	REAL	Fourth Numerical Input Default: 0.0
FRBK	DINT	Force Back Address Input Receiving the Force Back address “FBA” from the next lower level module. Note: Function Block has no priority to refuse Force Back acceptance.

Table 19 Addition Pin Input Parameters

Addition Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output Sum of all input variables and the adjustable offset value (internal value)
AMW	DINT	Auto Mode Warning It is a 32-bit alert that notice user something wrong either on the input or the output when the module is under Auto Mode
FBA	DINT	Force Back Address FBA exports the current function block Force Back address to the Force Back controlling target and it should connect to the controlling target “FRBK” field.
IA	DINT	Instance Address IA exports the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 20 Addition Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
7	OUTLO	Output (AO) has reached the Output Low Limit (OLL)
8	OUTHI	Output (AO) has reached the Output High Limit (OHL)
10	FORCEBACK	FORCEBACK return from the next level module
13	INHM	Restricted, including: FORCEBACK Restriction, Speed Limit, Upper and lower bounce restriction.
14	FBACKERR	Invalid input value for getting the proper force back value. Hints: INR1 should not be equal to ZERO.
15	AUTO	Function Block is under Auto Mode
16	MANUAL	Function Block is under Manual Mode

Table 21 AMW Definitions

Addition Module Internal Parameters

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from the connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter needs to access this function block. Default: 1
MSV	REAL	Manual Starting Value Set the function block First Run output value with this MSV when the Starting Type (STYP) is 0. Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, STYP could control the restart output value with reset or keep last output. 0: Start the function block with Manual Starting Value [Default]

		1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode. Modifiable in Manual Mode Not modifiable in Auto Mode e.g. AO=Output Percentage*ACTO
INR1	REAL	Input Ratio for IN1 Default: 1.0 (100% of IN1) e.g. 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field
INR2	REAL	Input Ratio for IN2 Default: 1.0 (100% of IN2) e.g. 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field
INR3	REAL	Input Ratio for IN3 Default: 1.0 (100% of IN3) e.g. 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field
INR4	REAL	Input Ratio for IN4 Default: 1.0 (100% of IN4) e.g. 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field
OSET	REAL	Formula Offset User could adjust the starting point of output value with below zero or above zero. Default: 0.0
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = Output Percentage * ACTO Default: 100.0
OHL	REAL	Output HI Limit Gives output percentage (same as MOP but in Auto Mode) a high limit to confirm the output value is under the high limit safe range. Range: 0.0~1.0 Default: 1.0
OLL	REAL	Output LO Limit Gives output percentage (same as MOP but in Auto Mode) a low limit to confirm the output value is above the low limit safe range. Range: 0.0~1.0 Default: 0.0
OSR	REAL	Output Speed Rate When the output value has been changed, it will change according to this OSR. Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: 1) Numerical Force Back (Value Tracking) will switch to

		ON when the module is under Manual Mode. 2) Restricted Force Back (Set Limit) will switch to ON when the module is under Auto Mode. 0: Disable the Force Back 1: Enable the Force Back [Default]
FINS (REFERENCE ONLY)	DINT	Force Back Instance A parameter that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output A parameter that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit.
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage
RSV2	DINT	32 bits reserved Force Back parameter for later usage

Table 22 Addition Module Internal Parameters

2.5.3 Description

2.5.3.1. Initialization

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value will be set as the Manual Starting Value (MSV).

When STYP is TRUE, it will initialize the output value (AO) and all Force Back values in both Numerical and Restricted Force Back control. The first cycle output value (AO) and all Force Back values will maintain as the last output value. If STYP set as TRUE at a brand new start, AO and all Force Back values should be initialized as ZERO.

2.5.3.2. Select Manual or Automatic Mode

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set as the Manual Output Percentage (MOP) of Actual Project Output Range (ACTO). “e.g. AO = MOP * ACTO”. The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) will be set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range).

Note:

1) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.5.3.3. Set Actual Project Output Range (ACTO)

ACTO should be set as the Maximum value of current project output range.

e.g. If the current project is controlling temperature, assuming the range is between 0 ~ 100 degrees, then ACTO should be set as 100.0.

2.5.3.4. Set Addition Force Back

This function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit).

1) Numerical Force Back (Value Tracking):
   - When Force Back Enable (FEN) is True under Manual Mode (MODE = False), the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0

2) Restricted Force Back (Set Limit):
   - When Force Back Enable (FEN is True under Auto Mode (MODE = True) and the current function block output has reached the Output HI Limit (OHL) or Output LO Limit (OLL), the current function block will calculate a Force Back Blocking value and enforce a connected upper level module OHL or OLL to follow.
   - When the current function block receives Restricted Force Back control from the lower level module, it will set the received value to its Output HI or LO Limit (OHL / OLL).

3) Special Condition in Force Back (For connecting “Switch” as lower level):
   - Switch takes two input values (PV1 & PV2), “Selected” and “Stand-by”. When the selected module receives Force Back Control from “Switch”, the stand-by module should automatically receive Numerical Force Back at the same time as from “Switch” in Auto mode.

4) Warning:
   - Under Force Back control, the first input rate of current module CANNOT be ZERO.
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - The Force Back control target MUST be the first input value.

- Force Back Enable only gives the current function block priority to choose between returning the Force Back control to the upper level. It is NOT giving the current function block authority to choose between accepting the Force Back control from the lower level or not.

2.5.3.5. Force Back Control Related Modules

The list below shows all modules that have Force Back Control functionality:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.5.3.6. Internal Parameters Default Values

The function block provides default values on the internal parameters convenient for collaboration.

Name	Data Type	Default Value	Comments
FLAG [REFERENCE ONLY]	DINT	Address Identification Default: 90	Cannot be modified by operator
FUNT [REFERENCE ONLY]	DINT	Function Block Type Default: 1	Cannot be modified by operator
MSV	REAL	Manual Starting Value: Default: 0.0	
STYP	BOOL	Starting Type Default: 0	Start the function block with MSV as output.
MOP	REAL	Manual Output Percentage Default: None	
INR1	REAL	Input Ratio for IN1 Default: 1.0 (100% of IN1)	100% of IN1
INR2	REAL	Input Ratio for IN2 Default: 1.0 (100% of IN2)	100% of IN2
INR3	REAL	Input Ratio for IN3 Default: 1.0 (100% of IN3)	100% of IN3
INR4	REAL	Input Ratio for IN4 Default: 1.0 (100% of IN4)	100% of IN4
OSET	REAL	Formula Offset Default: 0.0	
ACTO	REAL	Actual Project Output Range Default: 100.0	
OHL	REAL	Output HI limit Default: 1.0	Maximum 100%
OLL	REAL	Output LO limit Default: 0.0	Minimum 0%
OSR	REAL	Output Speed Rate Default: 0.05	Change at 5% per second
FEN	BOOL	Force Back Enable Default: 1	Start with Force Back Control

Table 23 Internal Parameters Default Value

2.6 Multiply

This “Multiply” function block provides a multiplication function and includes a Force Back input option.

2.6.1 Operation Formula

$$AO = OUTR*IN1*(IN2+INO2) + OSET$$

Note: AO = Output
OUTR = Output Ratio
IN1 = First Input Value
IN2 = Second Input Value
INO2 = Second Input Value Offset
OSET = Formula Offset

2.6.2 Parameters

Multiply Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
IN1	REAL	First input variable Default: 0.0
IN2	REAL	Second input variable Default: 0.0
FRBK	DINT	Force Back Address Input Receive the Force Back address “FBA” from the next lower level module. Note: Function Block has no priority to refuse Force Back acceptance.

Table 24 Multiply Pin Input Parameters

Multiply Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output AO is the formula result.
AMW	DINT	Auto Mode Warning It is a 32-bit alert that notice user something wrong either on the input or the output when the module is under Auto Mode.
FBA	DINT	Force Back Address FBA exports the current function block Force Back address to the Force Back controlling target and it should connect to the controlling target “FRBK” field.

IA	DINT	Instance Address IA exports the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block's internal parameters by receiving this IA.

Table 25 Multiply Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
7	OUTLO	Output (AO) has reached the Output Low Limit (OLL)
8	OUTHI	Output (AO) has reached the Output High Limit (OHL)
10	FORCEBACK	FORCEBACK return from the next level module
13	INHM	Restricted, including: FORCEBACK Restriction, Speed Limit, Upper and lower bounce restriction
14	FBACKERR	Invalid input value for getting the proper force back value. Hints: 1) Sum of IN2 and INO2 should not be equal to ZERO. 2) OUTR should not be equal to ZERO.
15	AUTO	Function Block is under Auto Mode
16	MANUAL	Function Block is under Manual Mode

Table 26 AMW Definitions

Multiply Internal Parameters

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter need to access this function block. Default: 2
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (ST) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, STYP could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value

MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode Modifiable in Manual Mode Not modifiable in Auto Mode e.g. AO=Output Percentage*ACTO
OUTR	REAL	Output Ratio Default: 1.0 (100% of output not including Offset)
INO2	REAL	IN2 Offset It gives users an opportunity to adjust the starting point of Input #2 Default: 0.0
OSET	REAL	Formula Offset It gives users an opportunity to adjust the starting point of the formula to below zero or above zero. If the Formula Ratio (RATE) equals to zero, AO still have this OSET as output in Auto Mode. Default: 0.0
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = Output Percentage * ACTO Default: 100.0
OHL	REAL	Output HI Limit Gives output percentage (same as MOP but in Auto Mode) a high limit to confirm the output value is under the high limit safe range. Range: 0.0~1.0 Default: 1.0
OLL	REAL	Output LO Limit Gives output percentage (same as MOP but in Auto Mode) a low limit to confirm the output value is above the low limit safe range Range: 0.0~1.0 Default: 0.0
OSR	REAL	Output Speed Rate When the output value has been changed, it will change according to this OSR Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: 1) Numerical Force Back (Value Tracking) will switch ON when the module is under Manual Mode 2) Restricted Force Back (Set Limit) will switch ON when the module is under Auto Mode 0: Disable the Force Back 1: Enable the Force Back [Default]
FINS (REFERENCE ONLY)	DINT	Force Back Instance A parameter that shows the type of Force Back receiving.

		0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output A parameter that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage
RSV2	DINT	32 bits reserved Force Back parameter for later usage

Table 27 Multiply Internal Parameters

2.6.3 Description

2.6.3.1. Initialization

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, the first cycle output value will be set as the Manual Starting Value (MSV).

When STYP is TRUE, it will initialize the output value (AO) and all Force Back values in both Numerical and Restricted Force Back control. The first cycle output value (AO) and all Force Back values will maintain as the last output value. If STYP set as TRUE at a brand new start, AO and all Force Back values should be initialized as ZERO.

2.6.3.2. Select Manual or Automatic Mode

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set as the Manual Output Percentage (MOP) of the Actual Project Output Range (ACTO). “e.g. AO = MOP * ACTO”. The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) should be set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range).

Note:

1) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.6.3.3. Set Actual Project Output Range (ACTO)

ACTO should be set as the Maximum value of current project output range.

e.g. If the current project is controlling temperature, assuming the range is between 0 ~ 100 degrees, then ACTO should be set as 100.0.

2.6.3.4. Set Multiply Force Back

This function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit).

1) Numerical Force Back (Value Tracking):
   - When Force Back Enable (FEN) is True under Manual Mode (MODE = False), the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0
2) Restricted Force Back (Set Limit):
   - When Force Back Enable (FEN) is True under Auto Mode (MODE = True) and the current function block output has reached the Output HI Limit (OHL) or Output LO Limit (OLL), the current function block will calculate a Force Back Blocking value and enforce a connected upper level module OHL or OLL to follow.
   - When current function block received Restricted Force Back control from lower level module, it will set the received value to its Output HI or LO Limit (OHL / OLL).
3) Special Condition in Force Back (For connecting “Switch” as lower level):
   - Switch takes two input values (PV1 & PV2), “Selected” and “Stand-by”. When the selected module receives Force Back Control from “Switch”, the stand-by module should automatically receive Numerical Force Back at the same time from “Switch” in Auto mode.
4) Warning:
   - Under Force Back control, the first input rate of current module CANNOT be ZERO
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - The Force Back control target MUST be the first input value.
   - Force Back Enable only gives the current function block priority to choose between returning the Force Back control to the upper level or not. It is NOT giving the current function block authority to choose between accepting the Force Back control from the lower level or not.

2.7 Divider

This “Divider” function block provides a division function and includes a Force Back input option.

2.7.1 Operation Formula

AO = (OUTR*(IN2+INO2)) / (IN1+INO1) + OSET

Note: AO = Output
OUTR = Output Rate
IN2 = Second Input Value
INO2 = Second Input Offset
IN1 = First Input Value
INO1 = First Input Offset
OSET = Formula Offset

2.7.2 Parameters

Divider Calling Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
IN1	REAL	First input variable Default: 0.0
IN2	REAL	Second input variable Default: 0.0
FRBK	DINT	Force Back Address Input Receiving the Force Back address “FBA” from the next lower level module. Note: Function Block has no priority to refuse Force Back acceptance.

Table 28 Divider Calling Pin Input Parameters

Divider Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output AO is the formula result.
AMW	DINT	Auto Mode Warning It is a 32-bit alert that notice user something wrong either on the input or the output when the module is under Auto Mode
FBA	DINT	Force Back Address FBA exports the current function block Force Back address to the Force Back controlling target and it should connect to the controlling

		target “FRBK” field.
IA	DINT	Instance Address IA exports the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 29 Divider Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
1	OVER_ZERO	The denominator (IN_1+K1) is zero
7	OUTLO	Output (AO) has reached the Output Low Limit (OLL)
8	OUTHI	Output (AO) has reached the Output High Limit (OHL)
10	FORCEBACK	FORCEBACK return from the next level
13	INHM	Restricted, including: FORCEBACK Restriction, Speed Limit, Upper and lower bounce restriction
14	FBACKERR	Invalid input value for getting the proper force back value. Hints: AO should not be equal to OSET.
15	AUTO	Function Block is under Auto Mode
16	MANUAL	Function Block is under Manual Mode

Table 30 AMW Definitions

Divider Internal Parameters

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter need to access this function block. Default: 3
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (STYP) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, ST could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value

MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode Modifiable in Manual Mode Not modifiable in Auto Mode e.g. AO=Output Percentage*ACTO
INO1	REAL	IN1 Offset It gives users an opportunity to adjust the starting point of Input #1 Default: 0.0
INO2	REAL	IN2 Offset It gives users an opportunity to adjust the starting point of Input #2 Default: 0.0
OUTR	REAL	Output Ratio Default: 1.0 (100% of output without OSET)
OSET	REAL	Formula Offset It gives users an opportunity to adjust the starting point of the formula to below zero or above zero. If the Formula Ratio (RATE) equals to zero, AO still have this OSET as output in Auto Mode. Default: 0.0
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = Output Percentage * ACTO Default: 100.0
OHL	REAL	Output HI Limit Gives output percentage (same as MOP but in Auto Mode) a high limit to confirm the output value is under the high limit safe range. Range: 0.0~1.0 Default: 1.0
OLL	REAL	Output LO Limit Gives output percentage (same as MOP but in Auto Mode) a low limit to confirm the output value is above the low limit safe range Range: 0.0~1.0 Default: 0.0
OSR	REAL	Output Speed Rate When the output value has been changed, it will change according to this OSR Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: 1) Numerical Force Back (Value Tracking) will switch ON when the module is under Manual Mode 2) Restricted Force Back (Set Limit) will switch ON when the module is under Auto Mode

		0: Disable the Force Back 1: Enable the Force Back [Default]
FINS (REFERENCE ONLY)	DINT	Force Back Instance A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output A variable that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage
RSV2	DINT	32 bits reserved Force Back parameter for later usage

Table 31 Divider Internal Parameters

2.7.3 Description

2.7.3.1. Initialization

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value will set as the Manual Starting Value (MSV).

When STYP is TRUE, it will initialize the output value (AO) and all Force Back values in both Numerical and Restricted Force Back control. The first cycle output value (AO) and all Force Back values will maintain as the last output value. If STYP set as TRUE at a brand new start, AO and all Force Back values should be initialized as ZERO.

2.7.3.2. Select Manual or Automatic Mode

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set to the Manual Output Percentage (MOP) of Actual Project Output Range (ACTO). "e.g. AO = MOP * ACTO" The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) will be set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range).

Note:

1) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.7.3.3. Set Actual Project Output Range (ACTO)

ACTO should set as the Maximum value of current project output range.

e.g. If the current project is controlling temperature, assuming the range is between 0 ~ 100 degrees, then ACTO should be set as 100.0.

2.7.3.4. Set Divider Force Back

This function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit).

1) Numerical Force Back (Value Tracking):
   - When Force Back Enable (FEN) is True under Manual Mode (MODE = False), the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0
2) Restricted Force Back (Set Limit):
   - When Force Back Enable (FEN is True under Auto Mode (MODE = True) and the current function block output has reached the Output HI Limit (OHL) or Output LO Limit (OLL), the current function block will calculate a Force Back Blocking value and enforce a connected upper level module OHL or OLL to follow.
   - When current function block received Restricted Force Back control from lower level module, it will set the received value to its Output HI or LO Limit (OHL / OLL).
3) Special Condition in Force Back (For connecting "Switch" as lower level):
   - Switch takes two input values (PV1 & PV2), "Selected" and "Stand-by". When the selected module receives Force Back Control from "Switch", the stand-by module

should automatically receive Numerical Force Back at the same time from “Switch” in Auto mode

4) Warning:
   - Under Force Back control, the first input rate of current module CANNOT be ZERO
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - The Force Back control target MUST be the first input value.
   - Force Back Enable only gives the current function block priority to choose between returning the Force Back control to the upper level or not. It is NOT giving the current function block authority to choose between accepting the Force Back control from the lower level or not.
   - Divider function block Force Back also only calculates the First Input Value for return.

2.7.3.5. Force Back Control Related Modules

The list below shows all modules that have Force Back Control functionality:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.7.3.6. Internal Parameters Default Values

The function block provides default values on the internal parameters convenient for collaboration. Here is the summary:

Name	Data Type	Default Value	Comments
FLAG [REFERENCE ONLY]	DINT	Address Identification Default: 90	Cannot be modified by operator
FUNT [REFERENCE ONLY]	DINT	Function Block Type Default: 3	Cannot be modified by operator
MSV	REAL	Manual Starting Value: Default: 0.0	
STYP	BOOL	Starting Type Default: 0	Start the function block with MSV as output.
MOP	REAL	Manual Output Percentage Default: None	
INO1	REAL	IN1 Offset Default: 0.0	
INO2	REAL	IN2 Offset Default: 0.0	
RATE	REAL	Formula Ratio Default: 1.0	100% of output without OSET
OSET	REAL	Formula Offset Default: 0.0	
ACTO	REAL	Actual Project Output Range Default: 100.0	
OHL	REAL	Output HI limit Default: 1.0	Maximum 100%
OLL	REAL	Output LO limit Default: 0.0	Minimum 0%
OSR	REAL	Output Speed Rate Default: 0.05	Change at 5% per second
FEN	BOOL	Force Back Enable Default: 1	Start with Force Back Control

Table 32 Internal Parameters Default Values

2.8 ParamReader

This “ParamReader” function block is built for users to access (read) Addition, Multiply, Divider, Servo, LeadLag, PID, Participation, Switch, Runback, DemandLimit, DEB400, BCA and Characterizer internal parameters in MoxGRAF (e.g. MoxGRAF’s FBD environment) and Citect. ParamReader can only access three internal parameters types: BOOL, DINT, and REAL. ParamReader only provides read operation. If a user wants to modify an internal parameter, user would need to use the ParamWriter function block to achieve that goal.

2.8.1 Parameters

ParamReader Calling Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
INST	DINT	Instance Address Input Address input of a selected function block that user want to access. e.g. Connect “INST” to PID “IA” output field for reading the LSP value.
LOCA	DINT	Parameter Location LOCA tells which parameter should be accessed in selected function block. e.g. If a user wants to access the 5th parameter in a selected function block, then user could input the number “5” in this LOCA field. Range of Addition is 1 – 15 Range of Multiply is 1 – 13 Range of Divider is 1 – 14 Range of LeadLag is 1 – 20 Range of Servo is 1 – 13 Range of PID is 1 – 31 Range of Participation is 1 – 48 Range of Switch is 1 – 10 Range of Runback is 1 – 23 Range of DemandLimit is 1 – 14 Range of DEB400 is 1 – 17 Range of BCA is 1 – 10 Range of Characherizer 1 – 43

Table 33 ParamReader Calling Parameters

ParamReader Return Parameters

Name	Data Type	Description
BOUT	BOOL	Boolean Type Output
DOUT	DINT	DINT Type Output
ROUT	REAL	REAL Type Output
STAT	DINT	Status 0: Not Activated (ParamReader Disable) 1: Current output is BOOL Type 2: Current output is DINT Type 3: Current output is REAL Type 4: Either LOCA or MODT has been out of range 5: Invalid Instance Address, “INST”
RESV	DINT	32 bits reserved Pin Output field for later usage

Table 34 ParamReader Return Parameters

Addition Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	INR1	REAL
7	INR2	REAL
8	INR3	REAL
9	INR4	REAL
10	OSET	REAL
11	ACTO	REAL
12	OHL	REAL
13	OLL	REAL
14	OSR	REAL
15	FEN	BOOL

Table 35 Addition Internal Parameters

Multiply Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	OUTR	REAL
7	INO2	REAL

8	OSET	REAL
9	ACTO	REAL
10	OHL	REAL
11	OLL	REAL
12	OSR	REAL
13	FEN	BOOL

Table 36 Multiply Internal Parameters

Divider Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	INO1	REAL
7	INO2	REAL
8	OUTR	REAL
9	OSET	REAL
10	ACTO	REAL
11	OHL	REAL
12	OLL	REAL
13	OSR	REAL
14	FEN	BOOL

Table 37 Divider Internal Parameters

LeadLag Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	PVR	REAL
7	LTIM	REAL
8	LAG1	REAL
9	LAG2	REAL
10	OSET	REAL
11	PVHL	REAL
12	PVLL	REAL
13	ACTO	REAL
14	WASH	BOOL
15	RSV3	DINT
16	RSV4	DINT
17	OHL	REAL
18	OLL	REAL

19	OSR	REAL
20	FEN	BOOL

Table 38 LeadLag Internal Parameters

Servo Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	FBMO	BOOL
7	PVR	REAL
8	CONS	REAL
9	ACTO	REAL
10	OHL	REAL
11	OLL	REAL
12	OSR	REAL
13	FEN	BOOL

Table 39 Servo Internal Parameters

PID Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	WSP [REFERENCE ONLY]	REAL
4	MSV	REAL
5	STYP	BOOL
6	MOP	REAL
7	PIDT	DINT
8	PVOS	REAL
9	PVR	REAL
10	LSP	REAL
11	LSPT	BOOL
12	PVTK	BOOL
13	PRAT	REAL
14	ITIM	REAL
15	DTIM	REAL
16	DBHL	REAL
17	DBLL	REAL
18	DBSR	REAL
19	WSPR	REAL
20	PVHR	REAL
21	PVLR	REAL
22	ACTO	REAL
23	OSET	REAL
24	PSET	REAL
25	PVHL	REAL
26	PVLL	REAL
27	DVHL	REAL
28	DVLL	REAL

29	OHL	REAL
30	OLL	REAL
31	OSR	REAL

Table 40 PID Internal Parameters

Participation Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	PNUM	DINT
4	WAO1 [REFERENCE ONLY]	REAL
5	WAO2 [REFERENCE ONLY]	REAL
6	WAO3 [REFERENCE ONLY]	REAL
7	WAO4 [REFERENCE ONLY]	REAL
8	MSV1	REAL
9	ST1	BOOL
10	MOP1	REAL
11	OR1	REAL
12	OST1	REAL
13	PST1	REAL
14	ACT1	REAL
15	OHL1	REAL
16	OLL1	REAL
17	OSR1	REAL
18	MSV2	REAL
19	ST2	BOOL
20	MOP2	REAL
21	OR2	REAL
22	OST2	REAL
23	PST2	REAL
24	ACT2	REAL
25	OHL2	REAL
26	OLL2	REAL
27	OSR2	REAL
28	MSV3	REAL
29	ST3	BOOL
30	MOP3	REAL
31	OR3	REAL
32	OST3	REAL
33	PST3	REAL
34	ACT3	REAL
35	OHL3	REAL
36	OLL3	REAL
37	OSR3	REAL
38	MSV4	REAL
39	ST4	BOOL
40	MOP4	REAL
41	OR4	REAL
42	OST4	REAL
43	PST4	REAL
44	ACT4	REAL
45	OHL4	REAL
46	OLL4	REAL
47	OSR4	REAL

48	FEN	BOOL

Table 41 Participation Internal Parameters

Switch Internal Parameters

Index	Data Type	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	ACTO	REAL
7	OHL	REAL
8	OLL	REAL
9	OSR	REAL
10	FEN	BOOL

Table 42 Switch Internal Parameters

Runback Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	STDR	REAL
7	FAST	REAL
8	RBT1	BOOL
9	RBT2	BOOL
10	RBT3	BOOL
11	RBT4	BOOL
12	RBT5	BOOL
13	RBV1	REAL
14	RBV2	REAL
15	RBV3	REAL
16	RBV4	REAL
17	RBV5	REAL
18	HTIM	REAL
19	ACTO	REAL
20	OHL	REAL
21	OLL	REAL
22	OSR	REAL
23	FEN	BOOL

Table 43 Runback Internal Parameters

DemandLimit Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT

3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	SPR1	REAL
7	SPR2	REAL
8	GAP	REAL
9	MERR	REAL
10	ACTO	REAL
11	OHL	REAL
12	OLL	REAL
13	OSR	REAL
14	FEN	BOOL

Table 44 DemandLimit Internal Parameters

DEB400 Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	P1R	REAL
7	ALFB	REAL
8	ALFT	REAL
9	BALT	REAL
10	LEAD	REAL
11	LAG	REAL
12	PSR	REAL
13	PSET	REAL
14	ACTO	REAL
15	OHL	REAL
16	OLL	REAL
17	OSR	REAL

Table 45 DEB400 Internal Parameters

BCA Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	EQAU	BOOL
4	OSB	BOOL
5	CTB	BOOL
6	STPB	BOOL
7	RSTB	BOOL
8	LOCK	BOOL
9	PW	DINT
10	TRV	DINT

Table 46 BCA Internal Parameters

Characterizer Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	SET	DINT
4	S1A	REAL
5	S1B	REAL
6	S2A	REAL
7	S2B	REAL
8	S3A	REAL
9	S3B	REAL
10	S4A	REAL
11	S4B	REAL
12	S5A	REAL
13	S5B	REAL
14	S6A	REAL
15	S6B	REAL
16	S7A	REAL
17	S7B	REAL
18	S8A	REAL
19	S8B	REAL
20	S9A	REAL
21	S9B	REAL
22	S10A	REAL
23	S10B	REAL
24	S11A	REAL
25	S11B	REAL
26	S12A	REAL
27	S12B	REAL
28	S13A	REAL
29	S13B	REAL
30	S14A	REAL
31	S14B	REAL
32	S15A	REAL
33	S15B	REAL
34	S16A	REAL
35	S16B	REAL
36	S17A	REAL
37	S17B	REAL
38	S18A	REAL
39	S18B	REAL
40	S19A	REAL
41	S19B	REAL
42	S20A	REAL
43	S20B	REAL

Table 47 Characterizer Internal Parameters

2.8.2 *Example of Connecting ParamReader*

ParamReader provides access to the assigned function block's internal parameters. The following diagram shows how ParamReader connecst to the PID internal parameters.

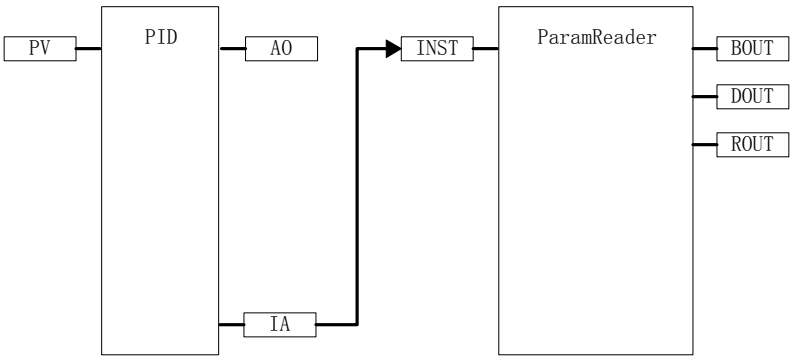


Figure 6 Setting of Using PID -> ParamReader

Note:

Instance Address Connections: PID instance address output (IA) is connected to the ParamReader instance address input (INST)

2.9 ParamWriter

This “ParamWriter” function block is designed for users to modify (update) Addition, Multiply, Divider, Servo, LeadLag, PID, Participation, Switch, Runback, DemandLimit, DEB400, BCA and Characterizer internal parameters in MoxGRAF (e.g. MoxGRAF’s FBD environment) and Citect. ParamWriter can only access three internal parameter types: BOOL, DINT, and REAL. Users can ONLY write or modify the value of a user assigned parameter from ParamWriter pin input or any other function block output. If user wants to get a value from an internal parameter of a module and write it to another internal parameter, then ParamReader should be connected to the ParamWriter as an input.

2.9.1 Parameters

ParamWriter Calling Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
INST	DINT	Instance Address Input Address input of a selected function block that user want to access. e.g. Connect “INST” to PID “IA” output field for modifying the LSP value.
LOCA	DINT	Parameter Location LOCA tells which parameter should be accessed in selected function block. e.g. If a user wants to access the 5th parameter in a selected function block, then user could input the number “5” in this LOCA field. Range of Addition is 1 – 15 Range of Multiply is 1 – 13 Range of Divider is 1 – 14 Range of LeadLag is 1 – 20 Range of Servo is 1 – 13 Range of PID is 1 – 31 Range of Participation is 1 – 48 Range of Switch is 1 – 10 Range of Runback is 1 – 23 Range of DemandLimit is 1 – 14 Range of DEB400 is 1 – 17 Range of BCA is 1 – 10 Range of Characherizer 1 – 43 Note: Check the section “Function Block Description” in ParamWriter specification for each function block internal parameters. Some function block internal parameters might be Read Only.

BIN	BOOL	BOOL Type Input Modifying Boolean type
DIN	DINT	DINT Type Input Modifying DINT type
RIN	REAL	REAL Type Input Modifying REAL type
RESV	DINT	32 bits reserved pin input field for later usage

Table 48 ParamWriter Calling Parameters

ParamWriter Return Parameters

Name	Data Type	Description
STAT	DINT	Status 0: Not Activated (ParamWriter Disable) 1: Current modifying is BOOL Type 2: Current modifying is DINT Type 3: Current modifying is REAL Type 4: Either LOCA or MODT has been out of range 5: Invalid Instance Address, “INST” 6: Read Only Internal Parameter

Table 49 ParamWriter Return Parameters

Addition Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	INR1	REAL
7	INR2	REAL
8	INR3	REAL
9	INR4	REAL
10	OSET	REAL
11	ACTO	REAL
12	OHL	REAL
13	OLL	REAL
14	OSR	REAL
15	FEN	BOOL

Table 50 Addition Internal Parameters

Multiply Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	OUTR	REAL

7	INO2	REAL
8	OSET	REAL
9	ACTO	REAL
10	OHL	REAL
11	OLL	REAL
12	OSR	REAL
13	FEN	BOOL

Table 51 Multiply Internal Parameters

Divider Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	INO1	REAL
7	INO2	REAL
8	OUTR	REAL
9	OSET	REAL
10	ACTO	REAL
11	OHL	REAL
12	OLL	REAL
13	OSR	REAL
14	FEN	BOOL

Table 52 Divider Internal Parameters

LeadLag Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	PVR	REAL
7	LTIM	REAL
8	LAG1	REAL
9	LAG2	REAL
10	OSET	REAL
11	PVHL	REAL
12	PVLL	REAL
13	ACTO	REAL
14	WASH	BOOL
15	RSV3	DINT
16	RSV4	DINT
17	OHL	REAL
18	OLL	REAL
19	OSR	REAL
20	FEN	BOOL

Table 53 LeadLag Internal Parameters

Servo Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	FBMO	BOOL
7	PVR	REAL
8	CONS	REAL
9	ACTO	REAL
10	OHL	REAL
11	OLL	REAL
12	OSR	REAL
13	FEN	BOOL

Table 54 Servo Internal Parameters

PID Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	WSP [REFERENCE ONLY]	REAL
4	MSV	REAL
5	STYP	BOOL
6	MOP	REAL
7	PIDT	DINT
8	PVOS	REAL
9	PVR	REAL
10	LSP	REAL
11	LSPT	BOOL
12	PVTK	BOOL
13	PRAT	REAL
14	ITIM	REAL
15	DTIM	REAL
16	DBHL	REAL
17	DBLL	REAL
18	DBSR	REAL
19	WSPR	REAL
20	PVHR	REAL
21	PVLR	REAL
22	ACTO	REAL
23	OSET	REAL
24	PSET	REAL
25	PVHL	REAL
26	PVLL	REAL
27	DVHL	REAL
28	DVLL	REAL
29	OHL	REAL
30	OLL	REAL
31	OSR	REAL

Table 55 PID Internal Parameters

Participation Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	PNUM	DINT
4	WAO1 [REFERENCE ONLY]	REAL
5	WAO2 [REFERENCE ONLY]	REAL
6	WAO3 [REFERENCE ONLY]	REAL
7	WAO4 [REFERENCE ONLY]	REAL
8	MSV1	REAL
9	ST1	BOOL
10	MOP1	REAL
11	OR1	REAL
12	OST1	REAL
13	PST1	REAL
14	ACT1	REAL
15	OHL1	REAL
16	OLL1	REAL
17	OSR1	REAL
18	MSV2	REAL
19	ST2	BOOL
20	MOP2	REAL
21	OR2	REAL
22	OST2	REAL
23	PST2	REAL
24	ACT2	REAL
25	OHL2	REAL
26	OLL2	REAL
27	OSR2	REAL
28	MSV3	REAL
29	ST3	BOOL
30	MOP3	REAL
31	OR3	REAL
32	OST3	REAL
33	PST3	REAL
34	ACT3	REAL
35	OHL3	REAL
36	OLL3	REAL
37	OSR3	REAL
38	MSV4	REAL
39	ST4	BOOL
40	MOP4	REAL
41	OR4	REAL
42	OST4	REAL
43	PST4	REAL
44	ACT4	REAL
45	OHL4	REAL
46	OLL4	REAL
47	OSR4	REAL
48	FEN	BOOL

Table 56 Participation Internal Parameters

Switch Internal Parameters

Index	Data Type	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	ACTO	REAL
7	OHL	REAL
8	OLL	REAL
9	OSR	REAL
10	FEN	BOOL

Table 57 Switch Internal Parameters

Runback Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	STDR	REAL
7	FAST	REAL
8	RBT1	BOOL
9	RBT2	BOOL
10	RBT3	BOOL
11	RBT4	BOOL
12	RBT5	BOOL
13	RBV1	REAL
14	RBV2	REAL
15	RBV3	REAL
16	RBV4	REAL
17	RBV5	REAL
18	HTIM	REAL
19	ACTO	REAL
20	OHL	REAL
21	OLL	REAL
22	OSR	REAL
23	FEN	BOOL

Table 58 Runback Internal Parameters

DemandLimit Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL

6	SPR1	REAL
7	SPR2	REAL
8	GAP	REAL
9	MERR	REAL
10	ACTO	REAL
11	OHL	REAL
12	OLL	REAL
13	OSR	REAL
14	FEN	BOOL

Table 59 DemandLimit Internal Parameters

DEB400 Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	MSV	REAL
4	STYP	BOOL
5	MOP	REAL
6	P1R	REAL
7	ALFB	REAL
8	ALFT	REAL
9	BALT	REAL
10	LEAD	REAL
11	LAG	REAL
12	PSR	REAL
13	PSET	REAL
14	ACTO	REAL
15	OHL	REAL
16	OLL	REAL
17	OSR	REAL

Table 60 DEB400 Internal Parameters

BCA Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	EQAU	BOOL
4	OSB	BOOL
5	CTB	BOOL
6	STPB	BOOL
7	RSTB	BOOL
8	LOCK	BOOL
9	PW	DINT
10	TRV	DINT

Table 61 BCA Internal Parameters

Characterizer Internal Parameters

Index	Name	Data Type
1	FLAG [REFERENCE ONLY]	DINT
2	FUNT [REFERENCE ONLY]	DINT
3	SET	DINT
4	S1A	REAL
5	S1B	REAL
6	S2A	REAL
7	S2B	REAL
8	S3A	REAL
9	S3B	REAL
10	S4A	REAL
11	S4B	REAL
12	S5A	REAL
13	S5B	REAL
14	S6A	REAL
15	S6B	REAL
16	S7A	REAL
17	S7B	REAL
18	S8A	REAL
19	S8B	REAL
20	S9A	REAL
21	S9B	REAL
22	S10A	REAL
23	S10B	REAL
24	S11A	REAL
25	S11B	REAL
26	S12A	REAL
27	S12B	REAL
28	S13A	REAL
29	S13B	REAL
30	S14A	REAL
31	S14B	REAL
32	S15A	REAL
33	S15B	REAL
34	S16A	REAL
35	S16B	REAL
36	S17A	REAL
37	S17B	REAL
38	S18A	REAL
39	S18B	REAL
40	S19A	REAL
41	S19B	REAL
42	S20A	REAL
43	S20B	REAL

Table 62 Characterizer Internal Parameters

2.9.2 Example of Connecting ParamWriter

ParamWriter provides access to modify the assigned function block's internal parameters. The following diagram shows how ParamWriter connects to PID internal parameters.

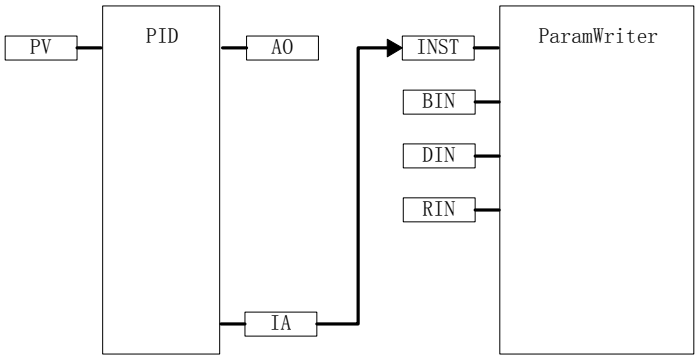


Figure 7 Settings of Using PID → ParamWriter

Note:

Instance Address Connections: PID instance address output (IA) is connected to the ParamWriter instance address input (INST).

2.10 Participation

This “Participation” function block takes one PV input value and splits the input into the maximum of four outputs (participants). The splitting method is respective of each participant’s ratio and offset. Since this function block has four outputs, some of parameter’s names might be grouped by the word “first”, “second”, “third” and “fourth” for identifying them as the same output. For example, if a parameter’s name ends with “2” or its full name starts with “Second”, it means that the parameter might affect the Second Output only. Participation also takes Common Logic input (from CLogic function block) and provides Force Back control for more control on a project. Each output acts like an individual function block with its own algorithm. An output parameter, Auto Mode Warning (AMW), would show in greater detail the operation status, especially in auto mode. Each bit of AMW represents different status, for more details please read through the section, Function Block Parameters, in this document.

2.10.1 Operation Formula

Basic Formula:

SUM (Outputs) = Demand

Note: Demand = PV Input values.

Output Rate and Offset Formula:

$$AO1 = (\frac{OPR1}{SUMR}) \times (Demand - SUMO) + OST1$$

Note: AO1 = First Output Value
OPR1 = First Output Rate
SUMR = Sum of all participated Output Rate
Demand = PV Input Value
SUMO = Sum of Offset values
OST1 = First Output Offset

Only Output Rate Formula:

$$AO1 = (\frac{OPR1}{SUMR}) \times Demand$$

Note: AO1 = First Output Value
OPR1 = First Output Rate
SUMR = Sum of all participated Output Rate
Demand = PV Input Value

Only Output Offset Formula:

$$AO1 = (\frac{1}{n}) \times (Demand - SUMO) + OST1$$

Note: AO1 = First Output Value
n = Total number of Output have been used
Demand = PV Input Value
SUMO = Sum of Offset values
OST1 = First Output Offset

2.10.2 Function Block Parameters

Participation Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
PV	REAL	Process Value (Demand) This is the Participation Process Value, same as “Demand” in function block formula Default: 0.0
MOD1	BOOL	First Output Operation Mode 0: Manual [Default] 1: Auto
TKV1	REAL	First Tracking Value Output value will set as this Tracking Value when the First Tracking Switch (TKS1) is TRUE. Default: 0.0
TKS1	BOOL	First Tracking Switch 0: Continue its process [Default] 1: Switch current function block operation mode to Manual and output will track with the First Tracking Value (TKV1). Note: Could force the function block to switch to Manual Mode.
GOP1	BOOL	First Go Preset Switch This function works under Auto mode ONLY. 0: No Preset 1: Set output as the First Pre-Set value (PST1) Note: Active under Auto mode ONLY
CLI1	DINT	First Common Logic Input PARTICIPATION has 13 conditional input as Common Logic Input Please check the following LOGI Definition Table.
FBK1	DINT	First Force Back Address Input Receiving the Force Back address “FBA” from the next level’s controller. Enter “-1” this field as Disable
MOD2	BOOL	Second Output Operation Mode 0: Manual [Default] 1: Auto
TKV2	REAL	Second Output Tracking Value Output value will set as this Tracking Value when the Second Output Tracking Switch (TKS1) is TRUE. Default: 0.0
TKS2	BOOL	Second Output Tracking Switch 0: Continue its process [Default] 1: Switch current function block operation mode to Manual and output will track with

		the Second Output Tracking Value (TKV2). Note: Could force the function block to switch to Manual Mode.
GOP2	BOOL	Second Output Go Preset Switch This function works under Auto mode ONLY. 0: No Preset 1: Set output as the Second Output Pre-Set value (PST2) Note: Active under Auto mode ONLY
CLI2	DINT	Second Common Logic Input PARTICIPATION has 13 conditional input as Common Logic Input Please check the following LOGI Definition Table.
FBK2	DINT	Second Force Back Address Input Receiving the Force Back address “FBA” from the next level’s controller. Enter “-1” this field as Disable
MOD3	BOOL	Third Output Operation Mode 0: Manual [Default] 1: Auto
TKV3	REAL	Third Output Tracking Value Output value will set as this Tracking Value when the Third Output Tracking Switch (TKS3) is TRUE. Default: 0.0
TKS3	BOOL	Third Output Tracking Switch 0: Continue its process [Default] 1: Switch current function block operation mode to Manual and output will track with the Third Output Tracking Value (TKV3). Note: Could force the function block to switch to Manual Mode.
GOP3	BOOL	Third Output Go Preset Switch This function works under Auto mode ONLY. 0: No Preset 1: Set output as the Third Output Pre-Set value (PST3) Note: Active under Auto mode ONLY
CLI3	DINT	Third Common Logic Input PARTICIPATION has 13 conditional input as Common Logic Input Please check the following LOGI Definition Table.
FBK3	DINT	Third Force Back Address Input Receiving the Force Back address “FBA” from the next level’s controller. Enter “-1” this field as Disable
MOD4	BOOL	Fourth Output Operation Mode 0: Manual [Default] 1: Auto
TKV4	REAL	Fourth Output Tracking Value Output value will set as this Tracking Value when the Fourth Output Tracking Switch (TKS4) is TRUE.

		Default: 0.0
TKS4	BOOL	Fourth Output Tracking Switch 0: Continue its process [Default] 1: Switch current function block operation mode to Manual and output will track with the Fourth Output Tracking Value (TKV4). Note: Could force the function block to switch to Manual Mode.
GOP4	BOOL	Fourth Output Go Preset Switch This function works under Auto mode ONLY. 0: No Preset 1: Set output as the Fourth Output Pre-Set value (PST4) Note: Active under Auto mode ONLY
CLI4	DINT	Fourth Common Logic Input PARTICIPATION has 13 conditional input as Common Logic Input Please check the following LOGI Definition Table.
FBK4	DINT	Fourth Force Back Address Input Receiving the Force Back address “FBA” from the next level’s controller. Enter “-1” this field as Disable
RSV1	DINT	First 32 bits reserved Pin Input field for later usage
RSV2	DINT	Second 32 bits reserved Pin Input field for later usage
RSV3	DINT	Third 32 bits reserved Pin Input field for later usage
RSV4	DINT	Fourth 32 bits reserved Pin Input field for later usage

Table 63 Participation Pin Input Parameters

LOGI Definitions

Definition	Description
XF	Exchange Failure
ABLK	Auto Mode Blocking
IBLK	Increment Blocking
DBLK	Decrement Blocking
IOVR	Increment Override
DOVR	Decrement Override
MOVR	Manual Mode Override
ROVR	Speed Rate Override
PCAN	Cancel Participation
ILMT	Reach Increment Limit
DLMT	Reach Decrement Limit
LOCO	Local Controlling
ASUS	Auto Suspension
ACK	Alarm Acknowledge
MMOD	LSDP Mode

Table 64 LOGI Definitions

Participation Pin Output Parameters

Name	Data Type	Description
AO1	REAL	First Output of Participation Function Block
CLO1	DINT	First Common Logic Status Output This is a 32-bits output that shows the logic status. Please check the CLO Definitions Table below for details.
AMW1	DINT	First Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions Table below for details.
AO2	REAL	Second Output Participation Function Block
CLO2	DINT	Second Common Logic Status Output This is a 32-bits output that shows the logic status. Please check the CLO Definitions Table below for details.
AMW2	DINT	Second Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions Table below for details.
AO3	REAL	Third Output of Participation Function Block
CLO3	DINT	Third Common Logic Status Output This is a 32-bits output that shows the logic status. Please check the CLO Definitions Table below for details.
AMW3	DINT	Third Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions Table below for details.
AO4	REAL	Fourth Output of Participation Function Block
CLO4	DINT	Fourth Common Logic Status Output This is a 32-bits output that shows the logic status. Please check the CLO Definitions Table below for details.
AMW4	DINT	Fourth Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions Table below for details.
FBA	DINT	Force Back Address FBA output the current function block Force Back address to the Force Back controlling target and it should connect to the “FRBK” field
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters

		by receiving this IA.

Table 65 Participation Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
7	OUTLO	AO has reached the LO Limit
8	OUTHI	AO has reached the HI Limit
9	GO_PRESET	Go Preset Switch is TRUE
10	FORCEBACK	Restricted by the lower level ForceBack
11	LOOPMANUAL	Function block is forced to loop in Manual mode, like Tracking Value (Tracking Switch is True)
13	INHM	Function Block is under Restricted, including ForceBack Restricted, Speed Rate Restricted, Upper and Lower Bounce Restricted
15	AUTO	Auto Mode
16	MANUAL	Manual Mode

Table 66 AMW Definitions

CLO Definitions

Bit Position	Definition	Description
1	ALARM	Alarm
2	XF	Exchange Failure
3	IRLS	Increment Release (Increment Allowed)
4	DRLS	Decrement Release (Decrement Allowed)
5	FBF	Feed Back Failure
6	IOVRD	Increment Override
7	DOVRD	Decrement Override
8	PCAN	Cancel Participation
9	ARLS	Auto Mode Release (Auto Allowed)
10	DUF	Drive Unit Failure
11	ALOSS	Auto Mode Loss
12	ATRPD	Auto Mode Trapped
13	ILMT	Reach Increment Limit
14	DLMT	Reach Decrement Limit
15	AINH	Auto Inhibit
16	AUTO	Auto Mode
17	LOCAL	Local Controlling
18	PATF	Participation Froze
19	REBAL	Rebalance
20	XCSCO	Cutout Exceeds Limits
31	ACK	Alarm Acknowledge
32	MMOD	LSDP Mode

Table 67 CLO Definitions

Participation Internal Parameters and Force Back

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function

		block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter need to access this function block. Default: 7
PNUM	DINT	Number of Participant Select the number of participants. 0: No Participant 1: One Participant using first output 2: Two Participant using first two outputs [Default] 3: Three Participant using first three outputs 4: Four Participant Warning: Each Output is corresponding to its input value. For example: Each input value name which ends with “1” is corresponding to the First Output. Input value name, which does NOT end with any number, are common parameters.
WAO [REFERENCE ONLY] (N/A)	REAL	Sum of Expected AO It displays the sum of all participants’ expected output. Each expected output is derived from the basic formula. Please DO NOT manually modify this field’s value.
WAO1 [REFERENCE ONLY]	REAL	First Participant Expected AO It displays the first participant expected output value. The expected output is derived from the basic formula. Please DO NOT manually modify this field’s value.
WAO2 [REFERENCE ONLY]	REAL	Second Participant Expected AO It displays the second participant expected output value. The expected output is derived from the basic formula. Please DO NOT manually modify this field’s value.
WAO3 [REFERENCE ONLY]	REAL	Third Participant Expected AO It displays the Third participant expected output value. The expected output is derived from the basic formula. Please DO NOT manually modify this field’s value.
WAO4 [REFERENCE ONLY]	REAL	Fourth Participant Expected AO It displays the fourth participant expected output value. The expected output is derived from the basic formula. Please DO NOT manually modify this field’s value.
MSV1	REAL	First Manual Starting Value: Set the function block First Output (AO1) value with this MSV1 at FIRST RUN when the First Starting Type (ST1) is 0. [Default]: 0.0
ST1	BOOL	First Starting Type After the First Output (AO1) operation is paused or stopped, ST1 could control the restart output value of First participant with reset or keep last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP1	REAL	First Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode for adjusting the

		First Output (AO1) e.g. AO1 = MOP1 * ACT1
OR1	REAL	First Output Ratio Determinate the ratio of the first output value. e.g. $AO1 = (\frac{OPR1}{SUMR}) \times (Demand - SUMO) + OST1$ Note: 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field Default: 0.25
OST1	REAL	First Output Offset User could adjust the starting point of the First Output Value with below zero or above zero. Default: 0.0
PST1	REAL	First Preset Value When the function block is under Auto mode and GOP1 is TURE, the First Output (AO1) will set as PST1. Default: 0.0
ACT1	REAL	First Actual Project Output Range ACT1 is the maximum value of the first output project range e.g. AO1 = MOP1 * ACT1 + OST1 Default: 100.0
OHL1	REAL	First Output HI Limit When the Output Percentage (same as MOP1 but in Auto Mode) has reached this OHL1, it will trigger OUTHI alarm in AMW. Default: 1.0
OLL1	REAL	First Output LO Limit When the Output Percentage (same as MOP1 but in Auto Mode) has reached this OLL1, it will trigger OUTLO alarm in AMW. Default: 0.0
OSR1	REAL	First Output Speed Rate OSR1 is controlling the output change rate. If the First Output value has been updated, then the output value needs to be changed according to this OSR1, instead of updating it immediately. Unit is % per second; Default: 0.05 (5% per second)
MSV2	REAL	Second Manual Starting Value: Set the function block Second Output (AO2) value with this MSV2 at FIRST RUN when the Second Starting Type (ST2) is 0. [Default]: 0.0
ST2	BOOL	Second Starting Type After the Second Output (AO2) operation is paused or stopped, ST2 could control the restart output value of Second participant with reset or keep last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP2	REAL	Second Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO2 = MOP2 * ACT2

OR2	REAL	Second Output Ratio Determinate the ratio of the second output value. e.g. $AO2 = (\frac{OPR2}{SUMR}) \times (Demand - SUMO) + OST2$ Note: 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field Default: 0.25 (25% of PV)
OST2	REAL	Second Output Offset User could adjust the starting point of the Second Output Value with below zero or above zero. Default: 0.0
PST2	REAL	Second Preset Value When the function block is under Auto mode and GOP2 is TURE, the second output will set as PST2. Default: 0.0
ACT2	REAL	Second Actual Project Output Range ACT2 is the maximum value of the second output project range e.g. AO2 = MOP2 * ACT2 + OST2 Default: 100.0
OHL2	REAL	Second Output HI Limit When the Output Percentage (same as MOP2 but in Auto Mode) has reached this OHL2, it will trigger OUTHI alarm in AMW. Default: 1.0
OLL2	REAL	Second Output LO Limit When the Output Percentage (same as MOP2 but in Auto Mode) has reached this OLL2, it will trigger OUTLO alarm in AMW. Default: 0.0
OSR2	REAL	Second Output Speed Rate OSR2 is controlling the output change rate. If the Second Output value has been updated, then the output value needs to be changed according to this OSR2, instead of updating it immediately. Unit is % per second; Default: 0.05 (5% per second)
MSV3	REAL	Third Manual Starting Value: Set the function block Third Output (AO3) value with this MSV3 at FIRST RUN when the Third Starting Type (ST3) is 0. [Default]: 0.0
ST3	BOOL	Third Starting Type After the Third Output (AO3) operation is paused or stopped, ST3 could control the restart output value of Third participant with reset or keep last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP3	REAL	Third Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO3 = MOP3 * ACT3
OR3	REAL	Third Output Ratio Determinate the ratio of the third output value. e.g.

		$AO3 = (\frac{OPR3}{SUMR}) \times (Demand - SUMO) + OST3$ Note: 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field Default: 0.25 (25%)
OST3	REAL	Third Output Offset User could adjust the starting point of the Third Output Value with below zero or above zero. Default: 0.0
PST3	REAL	Third Preset Value When the function block is under Auto mode and GOP3 is TURE, the third output will set as PST3. Default: 0.0
ACT3	REAL	Third Actual Project Output Range ACT3 is the maximum value of the third output project range e.g. AO3 = MOP3 * ACT3 + OST3 Default: 100.0
OHL3	REAL	Third Output HI Limit When the Output Percentage (same as MOP3 but in Auto Mode) has reached this OHL3, it will trigger OUTHI alarm in AMW. Default: 1.0
OLL3	REAL	Third Output LO Limit When the Output Percentage (same as MOP3 but in Auto Mode) has reached this OLL3, it will trigger OUTLO alarm in AMW. Default: 0.0
OSR3	REAL	Third Output Speed Rate OSR3 is controlling the output change rate. If the Third Output value has been updated, then the output value needs to be changed according to this OSR3, instead of updating it immediately. Unit is % per second; Default: 0.05 (5% per second)
MSV4	REAL	Fourth Manual Starting Value: Set the function block Fourth Output (AO4) value with this MSV3 at FIRST RUN when the Fourth Starting Type (ST4) is 0. [Default]: 0.0
ST4	BOOL	Fourth Starting Type After the Fourth Output (AO4) operation is paused or stopped, ST4 could control the restart output value of Fourth participant with reset or keep last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP4	REAL	Fourth Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO4 = MOP4 * ACT4
OR4	REAL	Fourth Output Ratio Determinate the ratio of the fourth output value. e.g. $AO4 = (\frac{OPR4}{SUMR}) \times (Demand - SUMO) + OST4$

		Note: 10%, just enter 0.1 on this field 100%, just enter 1.0 on this field Default: 0.25 (25%)
OST4	REAL	Fourth Output Offset User could adjust the starting point of the Fourth Output Value with below zero or above zero. Default: 0.0
PST4	REAL	Fourth Preset Value When the function block is under Auto mode and GOP4 is TURE, the fourth output will set as PST4. Default: 0.0
ACT4	REAL	Fourth Actual Project Output Range ACT4 is the maximum value of the fourth output project range e.g. AO4 = MOP4 * ACT4 + OST4 Default: 100.0
OHL4	REAL	Fourth Output HI Limit When the Output Percentage (same as MOP4 but in Auto Mode) has reached this OHL4, it will trigger OUTHI alarm in AMW. Default: 1.0
OLL4	REAL	Fourth Output LO Limit When the Output Percentage (same as MOP4 but in Auto Mode) has reached this OLL4, it will trigger OUTLO alarm in AMW. Default: 0.0
OSR4	REAL	Fourth Output Speed Rate OSR4 is controlling the output change rate. If the Fourth Output value has been updated, then the output value needs to be changed according to this OSR4, instead of updating it immediately. Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: Numerical Force Back (Value Tracking) will switch ON when the module is in both Manual and Auto Mode Restricted Force Back (Set Limit) will switch ON when the module is under Auto Mode 0: Disable the Force Back [Default] 1: Enable the Force Back
FINS (REFERENCE ONLY)	DINT	First Participant Force Back Instance (Receive) A variable shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output (Send Out) A variable that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.

FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit.
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	First Participant Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	First Participant Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	First Participant Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output provides “Switch” with an input value.
RSV6	DINT	32 bits reserved Force Back parameter for later usage
RSV7	DINT	32 bits reserved Force Back parameter for later usage
FIS2 (REFERENCE ONLY)	DINT	Second Participant Force Back Instance (Receive) A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FII2 (REFERENCE ONLY)	REAL	Second Participant Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV
FID2 (REFERENCE ONLY)	REAL	Second Participant Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV2 (REFERENCE ONLY)	REAL	Second Participant Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module
FIS3 (REFERENCE ONLY)	DINT	Third Participant Force Back Instance (Receive) A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FII3 (REFERENCE	REAL	Third Participant Force Back Input Increment Value (Receive)

ONLY)		This value receives from the lower level module for notifying that the output should not exceed FIIV
FID3 (REFERENCE ONLY)	REAL	Third Participant Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV3 (REFERENCE ONLY)	REAL	Third Participant Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module
FIS4 (REFERENCE ONLY)	DINT	Fourth Participant Force Back Instance (Receive) A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FII4 (REFERENCE ONLY)	REAL	Fourth Participant Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FID4 (REFERENCE ONLY)	REAL	Fourth Participant Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying the output should not be lower than FIDV.
FIV4 (REFERENCE ONLY)	REAL	Fourth Participant Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.

Table 68 Participation Internal Parameters and Force Back

2.10.3 Description

2.10.3.1. Initialization (First Run)

The Participation function block has four individual outputs. Each output has its own calculation elements which do not affect other outputs. So some of the parameters names might be repeated but can be identified by giving it a number at the end. The following naming conventions can be applied to all four groups of the output.

Examples: Starting Type (ST) is represented by ST1, ST2, ST3 and ST4
Manual Starting Value (MSV) is represented by MSV1, MSV2, MSV3 and MSV4
Starting Method (SM) is represented by SM1, SM2, SM3 and SM4
Operation Mode (MODE) is represented by MOD1, MOD2, MOD3 and MOD4

Under the situation when the Function Block is FIRST RUN, if the Starting Type (ST) is FALSE, then the first cycle output value will be set as the Manual Starting Value (MSV).

When ST is TRUE, then the first cycle output value will be set as the last output value. If the current starting process is a brand new starting process, when ST is TRUE, the FIRST RUN output value will be ZERO.

2.10.3.2. Select Manual or Automatic

The Participation function block has four individual outputs. Each output has its own calculation elements that do not affect other outputs. Some of the parameters names might be repeated but can be further identified by giving it a number at the end of its name. The following naming conventions can be applied to all four groups of the output.

Examples: Operation Mode (MODE) is represented by MOD1, MOD2, MOD3 and MOD4
Output (AO) is represented by AO1, AO2, AO3 and AO4
Actual Project Output Range (ACTO) is represented by ACT1, ACT2, ACT3 and ACT4
Output HI Limit (OHL) is represented by OHL1, OHL2, OHL3 and OHL4
Output LO Limit (OLL) is represented by OLL1, OLL2, OLL3 and OLL4

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set as the Manual Output Percentage (MOP) of Actual Project Output Range (ACTO). “e.g. AO = MOP * ACTO” The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) will be set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range).

Note:

1) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.
3) (Special) When a participant is under Manual mode, it should have the highest priority to share PV.

2.10.3.3. Set Number of Participants (PNUM)

The Participation function block allows the max of four participants to divide the Process Value. The Operator needs to specify the number of participants that will share the Process Value. PNUM has the following options:

1) “0” means no participant is going to share the Process Value.
2) “1” means only one participant is going to share the Process Value.
3) “2” means two participants are going to share the Process Value.
4) “3” means three participants are going to share the Process Value.
5) “4” means all four participants are going to share the Process Value.

Note: “PNUM” default value is “2”.

2.10.3.4. Go Pre-Set Mode (GOPS)

The Participation function block has four individual outputs. Each output has its own calculation elements which do not affect other outputs. Some of the parameters names might be repeated but can be further identifeid by giving it a number at the end of its name. The following naming conventions can apply to all four groups of the output.

Examples: Go Pre-Set (GOPS) is represented by GOP1, GOP2, GOP3 and GOP4
Preset Value (PSET) is represented by PST1, PST2, PST3 and PST4
Tracking Switch (TKSW) is represented by TKS1, TKS2, TKS3 and TKS4
Output (AO) is represented by AO1, AO2, AO3 and AO4

This Go Preset Switch (GOPS) is only activated in Auto mode. When it is set to TRUE, the output (AO) will track with the Preset Value (PSET). GOPS is different to the Tracking Switch (TKSW) mode because TKSW can activate in both Manual and Auto mode.

Note:
When a participant operates under Go Pre-Set Mode, it should have a higher priority than those normal auto mode participants on PV sharing.

2.10.3.5. Set Tracking Switch Mode (TKSW)

The Participation function block has four individual outputs. Each output has its own calculation elements which do not affect other outputs. Some of the parameters names might be repeated but can be further identied by giving it a number at the end of its name. The following naming conventions can apply to all four groups of the output.
Examples: Tracking Switch (TKSW) is represented by TKS1, TKS2, TKS3 and TKS4
Tracking Value (TKVA) is represented by TKV1, TKV2, TKV3 and TKV4
Operation Mode (MODE) is represented by MOD1, MOD2, MOD3 and MOD4
Output (AO) is represented by AO1, AO2, AO3 and AO4

When Tracking Switch is set to TRUE, the Function Block Operation Mode (MODE) will switch to Manual and Switch Function Block Output (AO) will track with the Tracking Value (TKVA). TKSW mode activates in Manual, Auto and Cascade modes.

Note: When a participant operates under Tracking Switch mode, it should have the priority to share PV as operating in Manual mode.

2.10.3.6. Set Participation Force Back

The Participation function block has four individual outputs. Each output has its own calculation elements which do not affect other outputs. Some of the parameters names might be repeated but can by further identified by giving it a number at the end of its name. The following naming conventions can apply to all four groups of the output.

Examples: Operation Mode (MODE) is represented by MOD1, MOD2, MOD3 and MOD4
Output (AO) is represented by AO1, AO2, AO3 and AO4
Output HI Limit (OHL) is represented by OHL1, OHL2, OHL3 and OHL4
Output LO Limit (OLL) is represented by OLL1, OLL2, OLL3 and OLL4

Participation function block could receive both Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit). Participation has Force Back Enable (FEN) on sending both Numerical Force Back and Restricted Force Back in Auto Mode. Since Participation has No Restricted Force Back in Manual Mode, Force Back Enable only sends out Numerical Force Back in Manual Mode. Please read the following conditions for details concerning this:

For all Participants in Manual Mode:

1) When Force Back Enable (FEN) is set, then automatically set Force Back Value for Numerical Force Back.

For all Participants in Auto Mode:

1) When Force Back Enable (FEN) is set, then automatically set Force Back Value for Numerical Force Back under the following conditions:
   - *Continue the Numerical Force Back from lower level module
   - *Received Decrease or Increase Override from Common Logic
   - *Received Manual Override from Common Logic
   - *When Input Switch (SW) either select PV1 or PV2 as output value.
   - *MEANS: need to be confirmed, if all participants able to receive CLogic Input.

2) When Force Back Enable (FEN) is set, then automatically set Force Back Value for Restricted Force Back under the following conditions:
   - All participants have reached the High (OHL) Limit.
   - All participants have reached the Low (OLL) Limit.
   - All participants have the combination of reaching OHL & OLL, and then compare the current PV with the sum of Expected Output (WAO1 + WAO2 + WAO3 + WAO4). If PV > SunExpOutput, then returns Force Back Inc. Value (FINC). If PV < SumExpOutput, then returns Force Back Dec. Value (FDEC).

3) Able to Receive both Numerical Force Back and Restricted Force Back.

The following define Numerical Force Back and Restricted Force Back in Participation function block:

1) Numerical Force Back (Value Tracking):
   - When Numerical Force Back is activated, the current function block will calculate a Force Back value and enforce a connected (selected) upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0
     (Formula is needed to set Force Back value)
2) Restricted Force Back (Set Limit):
   - When Participation function block received Restricted Force Back from lower level module, Participation will set the received value to its Output HI or LO Limit (OHL / OLL).
   - Able to send out Restricted Force Back when the all participants output either exceeds the OHL or OLL.
3) Warning:
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - By receiving Force Back control from lower level module, the current function block will not have priority to reject the order.

2.10.3.7. Common Logic Input & Output

The Participation function block has four individual outputs. Each output has its own calculation elements which do not affect other outputs. Some of the parameters names might be repeated but can be further identified by giving it a number at the end of its name. The following naming conventions can apply to all four groups of the output.

Examples: Common Logic Input (CLI) is represented by CLI1, CLI2, CLI3 and CLI4
Common Logic Output (CLO) is represented by CLO1, CLO2, CLO3 and CLO4

The Common Logic Input (CLI) has 13 input fields:
Exchange Failure (**XF**), Auto Mode Blocking (**ABLK**), Increment Blocking (**IBLK**), Decrement Blocking (**DBLK**), Increment Override (**IOVR**), Decrement Override (**DOVR**), Manual Mode Override (**MOVR**), Speed Rate Override (**ROVR**), Cancel Participation (**PCAN**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Suspend (**ASUS**), Local Controlling (**LOCO**), Alarm Acknowledge (**ACK**), LSDP Mode (**MMOD**)

The Common Logic Output (CLO) has 22 output fields:
Alarm (**ALARM**), Exchange Failure (**XF**), Increment Release (**IRLS**), Decrement Release (**DRLS**), Feed Back Failure (**FBF**), Increment Override (**IOVRD**), Decrement Override (**DOVRD**), Cancel Participation (**PCAN**), Automatic Release (**ARLS**), Drive Unit Failure (**DUF**), Auto Loss (**ALOSS**), Auto Trapped (**ATRPD**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Inhibit (**AINH**), Auto Mode (**AUTO**), Local Controlling (**LOCAL**), Partition Froze (**PATF**), Rebalance (**RBAL**), Cutout Exceeds Limit (**XCSCO**), Acknowledge (**ACK**), LSDP Mode (**MMOD**)

Note:
Please see the CLogic specification for more details.

2.10.3.8. Common Logic Input -- Manual Override (MOVR)

MOVR can be set from Common Logic Input, when both Increase Override (IOVR in Common Logic Input) and Decrease Override (DOVR in Common Logic Input) are TRUE, MOVR will be set to TRUE also. Once MOVR is set, the assigned participant's output will be held.

Please consider the following situation that MOVR will not take control in Participation:
1) Participation is in Manual mode, Function Block Operation Mode (MODE) is FALSE.
2) Participation is in Tracking Value mode (Tracking Switch, TKSW, is TRUE)
3) Participation is in Go Preset mode (Go Preset Switch, GOPS, is TRUE) [N/A]

2.10.3.9. Common Logic Input -- Increase & Decrease Override (IOVR & DOVR)

Increase Override (IOVR) works in both Manual and Auto mode. When IOVR is TRUE, Output (CV) will track with Output HI Limit (OHL).
Decrease Override (DOVR) works in both Manual and Auto mode. When DOVR is TRUE, CV will track with Output LO Limit (OLL).

Special Cases:
1) When both IOVR and DOVR are TRUE in Manual mode, DOVR should have the higher priority than IOVR.
2) When both IOVR and DOVR are set in Auto mode, MOVR would be set and current CV would retain at the pervious output value.

2.10.3.10. Common Logic Input -- Speed Rate Override (ROVR)

Speed Rate Override is one of the Common Logic Inputs. When ROVR is set to TRUE, the output should not be changed according to the Output Speed Rate (OSR).

Please consider the following situations that ROVR might or might not function in Participation:
1) When AO is changing in Tracking Value mode (Tracking Switch, TKSW is TRUE), ROVR might function.
2) When AO is changing in Go Preset mode (Go Preset Switch, GOPS, is TRUE), ROVR might function.
3) When AO is changing in Increase or Decrease Override (IOVR or DOVR is TRUE), ROVR might function.

2.10.3.11. Common Logic Input – Auto Suspend (ASUS)

ASUS authorizes the module to remain in auto mode operation in any case of loss of Auto mode control.

For instance:
When a participant only received XF from Common Logic module, that specific participant should operate in Manual mode and its Common Logic Status Output (CLO) should have Alarm, XF, ALOSS, ATRAP. If a participant only received XF and ASUS from Common Logic module, that specific participant should maintain in auto mode operation and its CLO should have Alarm, XF and ALOSS only.

Note: AMW should show user that the selected participant is still operating under auto mode, but CLO should not show.

2.10.3.12. Common Logic Input -- Alarm Acknowledge (ACK)

Alarm Acknowledge gives the operator authority to reset the Alarm on Common Logic Output. The function block will only manage to this ACK command once, when ACK is set to TRUE. If the operator wants to reset the Alarm a second time, ensure to reset ACK command before giving the request again.

2.10.3.13. Common Logic Input – Cancel Participation (PCAN)

Cancel Participation is one of the Common Logic Inputs. When PCAN is set, the particular participant should function individually as in Manual mode. However its output does not participate the sharing from Process Value (PV). It could still have the following operations:

1) Inc. & Dec Override (IOVR & DOVR),
2) Tracking Switch (TKSW),
3) Output collaboration by adjusting MOP.

In the normal case, Participant should have the following Common Logic Output Alarm as following:

1) Alarm,
2) Participation Cancellation (PCAN),
3) Auto Loss (ALOSS),
4) Auto Trap (ATRAP).

2.10.3.14. Setup with Switch function block

When Participation needs to connect Switch with one of its participants, only the first participant could do so. It is because Participation provides only one Instance Address (IA) as its ID in Switch. Participation would not work properly if the second, third or fourth participant connected to Switch.

2.10.3.15. Force Back Control Related Modules

The list below shows all modules that have Force Back Control functionality:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.10.3.16. Internal Parameters Default Values

The function block provides default values on the internal parameters convenient for collaboration. Here is the summary:

Name	Data Type	Default Value	Comments
FLAG [REFERENCE ONLY]	DINT	Address Identification Default: 90	Cannot be modified by operator
FUNT [REFERENCE ONLY]	DINT	Function Block Type Default: 7	Cannot be modified by operator
PNUM	DINT	Number of Participant Default: 2	
WAO1 [REFERENCE ONLY]	REAL	First Participant Expected AO Default: None	Cannot be modified by operator
WAO2 [REFERENCE ONLY]	REAL	Second Participant Expected AO Default: None	Cannot be modified by operator
WAO3 [REFERENCE ONLY]	REAL	Third Participant Expected AO Default: None	Cannot be modified by operator
WAO4 [REFERENCE ONLY]	REAL	Fourth Participant Expected AO Default: None	Cannot be modified by operator
MSV1	REAL	First Manual Starting Value Default: 0.0	
ST1	BOOL	First Starting Type Default: 0	Start the function block with MSV1 as output.
MOP1	REAL	First Manual Output Percentage Default: None	
OR1	REAL	First Output Ratio Default: 0.25	Receives 25% of PV Sum of all participants ratio = 100%
OST1	REAL	First Output Offset Default: 0.0	
PST1	REAL	First Preset Value Default: 0.0	
ACT1	REAL	First Actual Project Output Range Default: 100.0	
OHL1	REAL	First Output HI Limit Default: 1.0	Maximum 100%
OLL1	REAL	First Output LO Limit Default: 0.0	Minimum 0%
OSR1	REAL	First Output Speed Rate Default: 0.05	Change at 5% per second
MSV2	REAL	Second Manual Starting Value Default: 0.0	
ST2	BOOL	Second Starting Type Default: 0	Start the function block with MSV2 as output.

Name	Data Type	Default Value	Comments
MOP2	REAL	Second Manual Output Percentage Default: None	
OR2	REAL	Second Output Ratio Default: 0.25	Receives 25% of PV Sum of all participants ratio = 100%
OST2	REAL	Second Output Offset Default: 0.0	
PST2	REAL	Second Preset Value Default: 0.0	
ACT2	REAL	Second Actual Project Output Range Default: 100.0	
OHL2	REAL	Second Output HI Limit Default: 1.0	Maximum 100%
OLL2	REAL	Second Output LO Limit Default: 0.0	Minimum 0%
OSR2	REAL	Second Output Speed Rate Default: 0.05	Change at 5% per second
MSV3	REAL	Third Manual Starting Value Default: 0.0	
ST3	BOOL	Third Starting Type Default: 0	Start the function block with MSV2 as output.
MOP3	REAL	Third Manual Output Percentage Default: None	
OR3	REAL	Third Output Ratio Default: 0.25	Receives 25% of PV Sum of all participants ratio = 100%
OST3	REAL	Third Output Offset Default: 0.0	
PST3	REAL	Third Preset Value Default: 0.0	
ACT3	REAL	Third Actual Project Output Range Default: 100.0	
OHL3	REAL	Third Output HI Limit Default: 1.0	Maximum 100%
OLL3	REAL	Third Output LO Limit Default: 0.0	Minimum 0%
OSR3	REAL	Third Output Speed Rate Default: 0.05	Change at 5% per second
MSV4	REAL	Fourth Manual Starting Value Default: 0.0	
ST4	BOOL	Fourth Starting Type Default: 0	Start the function block with MSV2 as output.
MOP4	REAL	Fourth Manual Output Percentage Default: None	
OR4	REAL	Fourth Output Ratio Default: 0.25	Receives 25% of PV Sum of all participants ratio = 100%
OST4	REAL	Fourth Output Offset Default: 0.0	
PST4	REAL	Fourth Preset Value Default: 0.0	

Name	Data Type	Default Value	Comments
ACT4	REAL	Fourth Actual Project Output Range Default: 100.0	
OHL4	REAL	Fourth Output HI Limit Default: 1.0	Maximum 100%
OLL4	REAL	Fourth Output LO Limit Default: 0.0	Minimum 0%
OSR4	REAL	Fourth Output Speed Rate Default: 0.05	Change at 5% per second
FEN	BOOL	Force Back Enable Default: 1	Start with Force Back Control

Figure 8 Internal Parameters Default Values

2.10.3.17. General Example of Using Participation with DEB400 and DemandLimit

Participation is a divider that shares one input value (PV) to a maximum of four participants according to each participant demand as shown in the following graph:

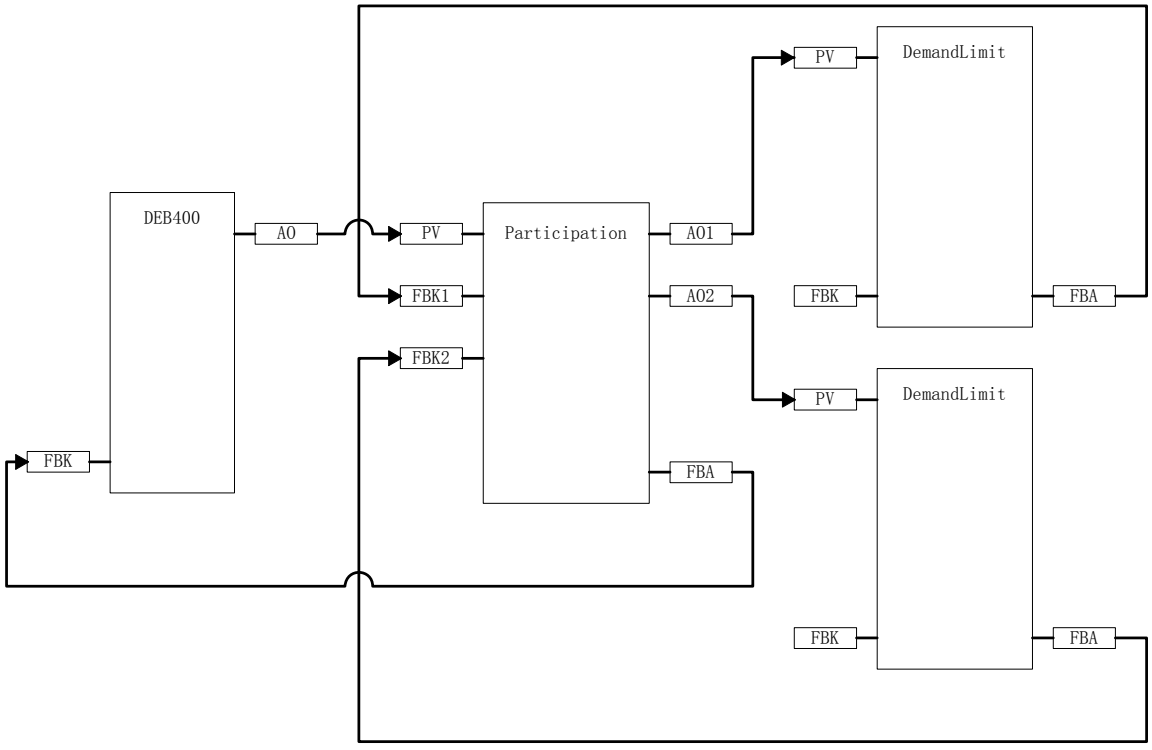


Figure 9 Setting of Using DEB400 → Participation → DemandLimit

Note:

1) **Output Connections**: DEB400 output is connected to the Participation input (PV). The Participation output (AO1 & AO2) is connected to different the DemandLimit inputs (PV).
2) **Force Back Connections**: The DemandLimit force back output is connected to the Participation force back input. The Participation force back output is connected to the DEB400 force back input.

2.11 Switch

This “Switch” function block has two PV input values and one output value. “Switch” itself does not have any mathematical relationship between the input and output, but an operator could select the ideal incoming source through the use of an input parameter, “SW”. “Switch” provides Common Logic input (from CLogic function block output) and Common Logic output (an output after “Switch” process) as process control. “Switch” could receive and provide Force Back commands to a connected module. Force Back control could unify the whole project input and output that reaches an efficiency and stability purpose. By increasing the safety-working environment, “Switch” has an output parameter, Auto Mode Warning (AMW), as a standard alarm for providing the operator with the most up-to-date information on the current status. Each bit of AMW represents a different meaning, for more details please read through the section, Function Block Parameters, in this document.

2.11.1 Operation Formula

Manual Mode Output Formula:

AO = MOP * ACTO

Note: AO = Function Block Output
MOP (or OP) = Manual Output Percentage (or Output Percentage in Auto mode)
ACTO = Actual Output Value

Auto Mode Output Formula:

When “SW” is True, AO = PV1
When “SW” is False AO = PV2

Note: SW = Input Switch
PV1 = First Process Value Input
PV2 = Second Process Value Input
AO = Function Block Output

2.11.2 Function Block Parameters

Switch Pin Internal Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
PV1	REAL	First Process Value Input One of the input values, when SW is TRUE
PV2	REAL	Second Process Value Input One of the input values, when SW is FALSE
ID1	DINT	First Input Value Function Block ID Receive the connected first input value function block Instance Address (IA) as its

		identification. Default: 0 (means no ID)
ID2	DINT	Second Input Value Function Block ID Receive the connected second input value function block Instance Address (AI) as its identification. Default: 0 (means no ID)
SW	BOOL	Switch Option Input Selected the ideal PV input value between PV1 and PV2 in Auto mode. 0: PV2 [Default] 1: PV1
TKVA	REAL	Tracking Value Output value will set as this Tracking Value when Tracking Switch (TKSW) is TRUE. Default: 0.0
TKSW	BOOL	Tracking Switch 0: Continue its process [Default] 1: Switch current function block operation mode to Manual and output will track with Tracking Value (TKVA). Note: Could force the function block to switch to Manual Mode.
LOGI	DINT	Common Logic Input Switch has 13 conditional inputs as Common Logic Input. Please check the following LOGI Definition Table.
FRBK	DINT	Force Back Address Input Receiving the Force Back address “FBA” from the next level’s controller. Set this field to “-1” if no Force Back
RSV1	DINT	32 bits reserved Pin Input field for later usage
RSV2	DINT	32 bits reserved Pin Input field for later usage

Table 69 Switch Pin Internal Parameters

LOGI Definitions

Definition	Description
XF	Exchange Failure
ABLK	Auto Mode Blocking
IBLK	Increment Blocking
DBLK	Decrement Blocking
IOVR	Increment Override
DOVR	Decrement Override
MOVR	Manual Mode Override
ROVR	Speed Rate Override
PCAN	Cancel Participation
ILMT	Reach Increment Limit
DLMT	Reach Decrement Limit
ASUS	Auto Suspension
LOCO	Local Controlling

ACK	Alarm Acknowledge
MMOD	LSDP Mode

Table 70 LOGI Definitions

Switch Pin Output Parameters

Name	Data Type	Description
AO	REAL	Switch Function Block Output
LOGO	DINT	Common Logic Status Output This is a 32-bits output that shows the logic status.
AMW	DINT	Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions Table below for details.
FBA	DINT	Force Back Address FBA exports the current function block Force Back Address to upper level connected modules (the module which connected to PV1 and PV2 input). FBA should connect to "FRBK" input field.
IA	DINT	Instance Address IA output the current function block internal parameters address. E.g. ParamReader or ParamWriter could gain access to function block's internal parameters by receiving this IA.
RSV3	DINT	32 bits reserved Pin Input field for later usage

Table 71 Switch Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
1	SEL_PV1	First Process Value is selected
2	SEL_PV2	Second Process Value is selected
7	OUTLO	AO has reached the LO Limit
8	OUTHI	AO has reached the HI Limit
10	FORCEBACK	Restricted by the lower level ForceBack
11	LOOPMANUAL	Return on Manual Mode, meansTracking Switch (TKSW).
13	INHM	Function Block is under Restricted, including ForceBack Restricted (receives Numerical and Restricted Force Back control from lower level module), Upper and Lower Bounce Restricted, Common Logic Restriction (like Decrease Override, Increase Override, Manual Override etc.), Output Rate Restriction (Output Increase or Decrease Exceed the Output Rate)
15	AUTO	Current function block operation mode is Auto
16	MANUAL	Current function block operation mode is Manual

Table 72 AMW Definitions

LOGO Definitions

Bit Position	Definition	Description
1	ALARM	Alarm
2	XF	Exchange Failure
3	IRLS	Increment Release (Increment Allowed)
4	DRLS	Decrement Release (Decrement Allowed)
5	FBF	Feed Back Failure
6	IOVRD	Increment Override
7	DOVRD	Decrement Override
8	PCAN	Cancel Participation
9	ARLS	Auto Mode Release (Auto Allowed)
10	DUF	Drive Unit Failure
11	ALOSS	Auto Mode Loss
12	ATRPD	Auto Mode Trapped
13	ILMT	Reach Increment Limit
14	DLMT	Reach Decrement Limit
15	AINH	Auto Inhibit
16	AUTO	Auto Mode
17	LOCAL	Local Controlling
18	PATF	Participation Froze
19	REBAL	Rebalance
20	XCSCO	Cutout Exceeds Limits
31	ACK	Acknowledge (Alarm Cancellation)
32	MMOD	LSDP Mode

Table 73 LOGO Definitions

Switch Internal Parameters and Force Back

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter needs to access this function block. Default: 8
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (STYP) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, STYP could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO=Output Percentage*ACTO Note: No need to give default value since

		function block initial with MSV.
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = Output Percentage * ACTO Default: 100.0
OHL	REAL	Output HI limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OHL, it will trigger OUTHI alarm in AMW. Default: 1.0 Range: 0.0 ~ 1.0
OLL	REAL	Output LO limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OLL, it will trigger OUTLO alarm in AMW. Default: 0.0 Range: 0.0 ~ 1.0
OSR	REAL	Output Speed Rate OSR is controlling the output change rate. If the output value has been updated, then output value needs to be changed according to this OSR, instead of updating the output value immediately. Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: Numerical Force Back (Value Tracking) will switch to ON when the module is in both Manual and Auto Mode Restricted Force Back (Set Limit) will switch to ON when the module is under Auto Mode 0: Disable the Force Back 1: Enable the Force Back [Default]
RSV4	DINT	32 bits reserved Pin Input field for later usage
RSV5	DINT	32 bits reserved Pin Input field for later usage
FINS (REFERENCE ONLY)	DINT	Force Back Instance (Receive) A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output (Send Out) A variable that shows the type of Force Back sending. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking 8: Force Back Tracking on the First PV Input. 16: Force Back Tracking on the Second PV Input.
FVLU (REFERENCE	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper

ONLY)		level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output high limit.
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV6	DINT	32 bits reserved Force Back parameter for later usage
RSV7	DINT	32 bits reserved Force Back parameter for later usage

Table 74 Switch Internal Parameters and Force Back

2.11.3 Description

2.11.3.1. Initialization (First Run)

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value will be set as the Manual Starting Value (MSV).

When STYP is TRUE, then the first cycle output value will be set as the last output value. If the current starting process is a brand new starting, when STYP is TRUE, the FIRST RUN output value will be ZERO.

2.11.3.2. Select Manual or Automatic

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) should be set as the Manual Output Percentage (MOP) of Actual Project Output Range (ACTO). “e.g. AO = MOP * ACTO”. The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) should be set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range or Tracking Value).

Warning:

1) If the operator pre-sets MOP for Manual mode before the function block is enabled, AO should still use the MSV. In fact MOP should be overwritten by the real time MSV at the First Run period.
2) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
3) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately (with no OSR restriction) then continue tracking the formula calculation result.

2.11.3.3. Set Tracking Switch Mode (TKSW)

When Tracking Switch is set to TRUE, the Function Block Operation Mode (MODE) will switch to Manual and Switch Function Block Output (AO) will track with Tracking Value (TKVA). TKSW mode activates in both Manual and Auto mode. When function block is tracing the Tracking Value, the output limit (OHL & OLL) and Common Logic Input (Increase Override, Decrease Override, Manual Override, Increase Blocking, and Decrease Blocking) cannot restrict the Tracking Value limits.

2.11.3.4. Set Switch Force Back

Switch function block could receive both Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit). Switch has Force Back Enable (FEN) on sending both Numerical Force Back and Restricted Force Back in Auto Mode. Since Switch has No Restricted Force Back in Manual Mode, Force Back Enable only sends out Numerical Force Back in Manual Mode. Please read the following conditions for details:

Manual Mode:

1) When Force Back Enable (FEN) is set, and then automatically set Force Back Value for Numerical Force Back.
2) Both connected to Switch PV1 and PV2 function blocks should receive the same Numerical Force Back.

Auto Mode:

1) When Force Back Enable (FEN) is set, then automatically set Force Back Value for Numerical Force Back under the following conditions:
   - Continue the Numerical Force Back from lower level module
   - Received Decrease or Increase Override from Common Logic
   - Received Manual Override from Common Logic
   - “Switch” could receive the maximum of two input values from both selected and stand-by modules. If “Switch” is exporting the selected module input value (Switch has not receive any Force Back Control from lower level module or restriction from Common Logic), the stand-by module should receive the Numerical Force Back. The stand-by module should have the same value as the selected module output.
2) When Force Back Enable (FEN) is set, then automatically set Force Back Value for Restricted Force Back under the following conditions:
   - Output value has reached the HI (OHL) or LO (OLL) limit
3) Able to Receive both Numerical Force Back and Restricted Force Back.

The following define Numerical Force Back and Restricted Force Back in Switch function block:

1) Numerical Force Back (Value Tracking):
   - When Numerical Force Back is activated, the current function block will calculate a Force Back value and enforce a connected (selected) upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0
     (Formula is needed to set Force Back value)
2) Restricted Force Back (Set Limit):

- When Switch function block received Restricted Force Back from lower level module, Switch will set the received value to its Output HI or LO Limit (OHL / OLL).
- Able to send out Restricted Force Back when the output either exceeds the OHL or OLL.

3) Special Condition in Force Back (For connecting “Switch” as lower level):
   - Switch takes two input values (PV1 & PV2), “Selected” and “Stand-by”. When the selected module receives Force Back Control from “Switch”, the stand-by module should automatically receive Numerical Force Back at the same time from “Switch” in Auto mode.
4) Warning:
   - Make sure that the current Force Back Address (FBA) is connected to the Force Back control target.
   - By receiving Force Back control from lower level module, the current function block will not have the priority to reject the order.

2.11.3.5. Common Logic Input & Output

The Common Logic Input (LOGI) has 13 input fields:
Exchange Failure (**XF**), Auto Mode Blocking (**ABLK**), Increment Blocking (**IBLK**), Decrement Blocking (**DBLK**), Increment Override (**IOVR**), Decrement Override (**DOVR**), Manual Mode Override (**MOVR**), Speed Rate Override (**ROVR**), Cancel Participation (**PCAN**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Suspend (**ASUS**), Local Controlling (**LOCO**), Alarm Acknowledge (**ACK**), LSDP Mode (**MMOD**)

The Common Logic Output (LOGO) has 22 output fields:
Alarm (**ALARM**), Exchange Failure (**XF**), Increment Release (**IRLS**), Decrement Release (**DRLS**), Feed Back Failure (**FBF**), Increment Override (**IOVRD**), Decrement Override (**DOVRD**), Cancel Participation (**PCAN**), Automatic Release (**ARLS**), Drive Unit Failure (**DUF**), Auto Loss (**ALOSS**), Auto Trapped (**ATRPD**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Inhibit (**AINH**), Auto Mode (**AUTO**), Local Controlling (**LOCAL**), Partition Froze (**PATF**), Rebalance (**RBAL**), Cutout Exceeds Limit (**XCSCO**), Acknowledge (**ACK**), LSDP Mode (**MMOD**)

Note: Please refer to the CLogic specification for more details.

2.11.3.6. Common Logic Input -- Manual Override (MOVR)

MOVR can be set from the Common Logic Input, i.e. when both Increase Override (IOVR in Common Logic Input) and Decrease Override (DOVR in Common Logic Input) are TRUE, MOVR will be TRUE. Once MOVR is set, the Output (AO) locked at the current value.

Please consider the following situation that MOVR will not take control in Switch:
1) Switch is in Manual mode, Function Block Operation Mode (MODE) is FALSE.
2) Switch is in Tracking Value mode (Tracking Switch, TKSW, is TRUE)

2.11.3.7. Common Logic Input -- Increase & Decrease Override (IOVR & DOVR)

Increase Override (IOVR) works in both Manual and Auto mode. When IOVR is TRUE, the Output (CV) will track with the Output HI Limit (OHL).
Decrease Override (DOVR) works in both Manual and Auto mode. When DOVR is TRUE, CV will track with the Output LO Limit (OLL).

When both IOVR and DOVR are TRUE in Manual mode, DOVR should have a higher priority than IOVR. When both IOVR and DOVR are set in Auto mode, MOVR would be set and the current CV would retain at the pervious output value.

2.11.3.8. Common Logic Input -- Speed Rate Override (ROVR)

Speed Rate Override is one of the Common Logic Inputs. When ROVR is set to TRUE, the output will not change according to the Output Speed Rate (OSR).

Please consider the following situations that ROVR might or might not function in Switch:

1) When AO is changing in Tracking Value mode (Tracking Switch, TKSW is TRUE), ROVR might function.
2) When AO is changing in Increase or Decrease Override (IOVR or DOVR is TRUE), ROVR might function.

2.11.3.9. Common Logic Input – Auto Suspend (ASUS)

ASUS authorizes the module to remain in auto mode operation in case of loss of Auto mode control.

For instance:
When Switch receives only XF from Common Logic module, Switch should operate in Manual mode and its Common Logic Status Output (LOGO) should have Alarm, XF, ALOSS, ATRAP. If Switch receives only XF and ASUS from Common Logic module, Switch should maintain in Auto mode operation and its LOGO should have Alarm, XF and ALOSS only.

Note:
AMW should show the user that the module is still operating under auto mode, but LOGO should not be displayed.

2.11.3.10. Common Logic Input -- Alarm Acknowledge (ACK)

The Alarm Acknowledge parameter gives the operator authority to reset the Alarm on the Common Logic Output. The function block will only manage the ACK command once, when ACK is set TRUE. If the operator wants to reset the Alarm a second time, ensure to reset the ACK command before giving the request again.

2.11.3.11. Set Auto Mode Warning (AMW)

Auto Mode Warning (AMW) mainly provides a service in Auto mode to let the operator know the function block's the most up-to-date status. Switch shows eight kinds of conditions, they are:

- SEL_PV1
- SEL_PV2
- OUTLO
- OUTHI
- FORCEBACK
- RESTRICTED
- AUTO
- MANUAL

SEL_PV1 is set when PV1 is selected in Auto mode. In the other words, SW is True.
SEL_PV2 is set when PV2 is selected in Auto mode. In the other words, SW is False
OUTLO is set when AO has reached the Output Lo Limit. As a reminder: AO = OP * ACTO and the Output High/Low Limit is compared with the Operation Percentage (same as MOP in Auto mode).
OUTHI is set when AO has reached the Output Hi Limit. As a reminder: AO = OP * ACTO and the Output High/Low Limit is compared with the Operation Percentage (same as MOP in Auto mode).
FORCEBACK is set when function block has received any Force Back control from a lower level module.
INHM is set when the function block has the following conditions:

- ForceBack Restricted (When the function block has received Force Back control in Auto mode)
- Speed Rate Restricted (When the Output is increasing or decreasing, the speed rate has exceeded the OSR)

- Upper and Lower Bounce Restricted (Output has reached the Output High/Low Limit)
- Common Logic Restriction (when Decrease Override, Increase Override, or Manual Override is set in the Common Logic Input).

AUTO is set when the function block is under Automatic mode
MANUAL is set when the function block is under Manual mode

2.11.3.12. Connecting to Switch

When any function block provides its output to "Switch" as one of the PV inputs, that function block needs to provide its Instance Address (IA) as Switch's ID. ID1 should have the identification from the connected PV1 function block. ID2 should have the identification from the connected PV2 function block. If the IDs do not have the corresponding inputs, the standby PV input provider would not track with the selected PV input provider. In the worst scenario, the Switch function block does not listen to the PV inputs when it does not receive the proper ID inputs.

Note:
When SW from Switch function block is "0", PV2 and ID2 input provider should be the selected input provider and PV1 and ID1 input provider should be the standby input provider.

2.11.3.13. Force Back Control Related Modules

The list below shows all modules that have Force Back Control functionality:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.11.3.14. Internal Parameters Default Values

The function block provides default values on the internal parameters convenient for collaboration. Here is the summary:

Name	Data Type	Default Value	Comments
FLAG [REFERENCE ONLY]	DINT	Address Identification Default: 90	Cannot be modified by operator
FUNT [REFERENCE ONLY]	DINT	Function Block Type Default: 8	Cannot be modified by operator
MSV	REAL	Manual Starting Value: Default: 0.0	Start the function block with MSV as output.
STYP	BOOL	Starting Type Default: 0	
MOP	REAL	Manual Output Percentage Default: None	
ACTO	REAL	Actual Project Output Range Default: 100.0	

OHL	REAL	Output HI limit Default: 1.0	Maximum 100%
OLL	REAL	Output LO limit Default: 0.0	Minimum 0%
OSR	REAL	Output Speed Rate Default: 0.05	Change at 5% per second
FEN	BOOL	Force Back Enable Default: 1	Start with Force Back Control

Table 75 Internal Parameters Default Values

2.11.3.15. General Example of Using Switch as Redundancy Function Block

Switch has two inputs (two loops) and output the selected loop. If Switch is connected to two similar loops, it could provide a redundancy function as it shows in the following diagram:

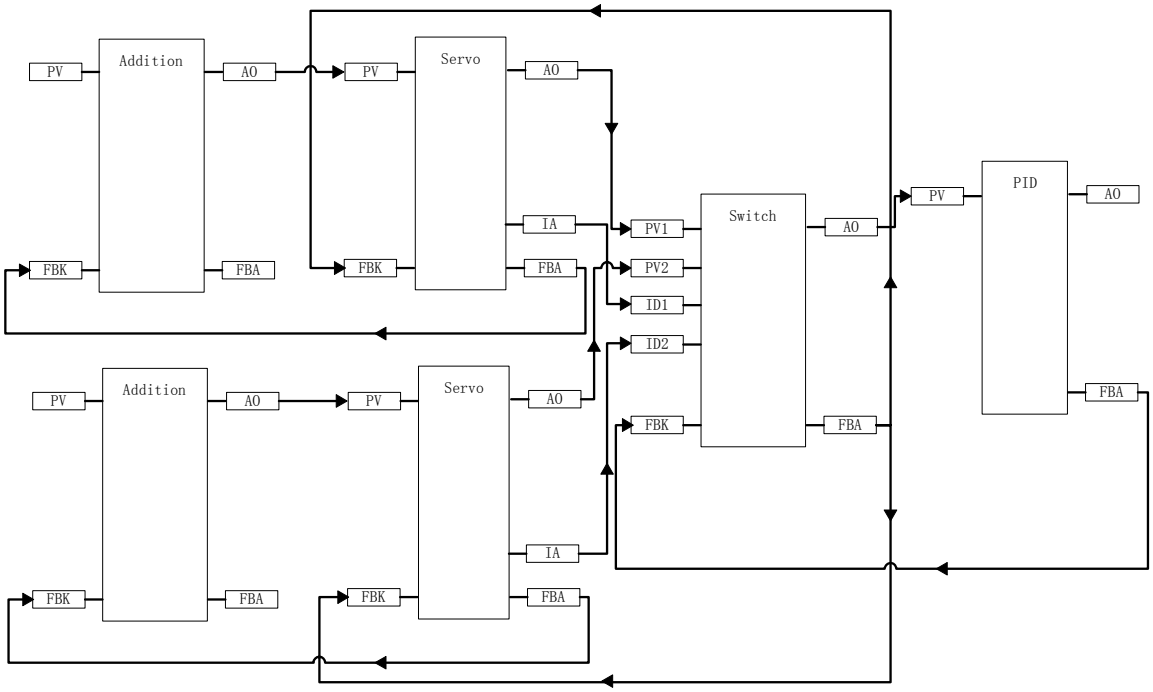


Figure 10 Settings of Using Addition -> Servo -> Switch -> PID

Note:

1) **Output Connections:** Each Addition output connected to a different Servo input (PV). Each Servo output is connected to a Switch input (PV1 and PV2). The Switch output is connected to the PID input (PV).
2) **Instance Address Connections:** Each Servo Instance Address Output (IA) is connected to a different Switch ID input (ID1 & ID2).
3) **Force Back Connections:** The PID force back address output is connected to the Switch force back address input. The Switch force back address output is connected to both Servos' force back address inputs. Each Servo's force back address output is connected to the Addition force back address input that it had interaction with.

2.12 Runback

This “Runback” function block provides a tracking runback value service when operator requests it, otherwise “Runback” will track with the input (Process Value, PV) according to its Output HI Limit (OHL), Output LO Limit (OLL) and Output Speed Rate (OSR). “Runback” has five logical inputs. When one of the logical inputs is set and the output (AO) is bigger than the selected runback value, AO will track with the runback value according to the selected runback rate. If more than one logical input is set, “Runback” should track with the smallest runback value with respect to the selected Rate Type. When all the conditions of “Runback” are fulfilled and the Holding Time (HTIM) is ZERO, AO should retain at the runback value; otherwise AO should only maintain at the runback value for a period of Holding Time. In a normal operation without runback command, AO should track with PV according to OSR. If any error occurs in Auto mode, Auto Mode Warning (AMW) will display each operation error. Each bit of AMW represents a different error message, for more details please read through the section, Function Block Parameters, in this document.

2.12.1 Function Block Parameters

Runback Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
PV	REAL	Process Value This is Runback function block Process Value input. Default: 0.0
RBK1	BOOL	First Runback Command When it is enabled, function block should track with First Runback Value (RBV1). If more than one Runback commands is set, function block should track with the command that has lower Runback Value. 0: No First Runback Control 1: Select First Runback Control
RBK2	BOOL	Second Runback Command When it is enabled, function block should track with Second Runback Value (RBV2). If more than one Runback commands are set, function block should track with the command that has lower Runback Value. 0: No Second Runback Control 1: Select Second Runback Control
RBK3	BOOL	Third Runback Command When it is enabled, function block should track with Third Runback Value (RBV3). If more than one Runback commands are set, function block should track with the command that has lower Runback Value.

		0: No Third Runback Control 1: Select Third Runback Control
RBK4	BOOL	Fourth Runback Command When it is enabled, function block should track with Fourth Runback Value (RBV4). If more than one Runback commands are set, function block should track with the command that has lower Runback Value. 0: No Fourth Runback Control 1: Select Fourth Runback Control
RBK5	BOOL	Fifth Runback Command When it is enabled, function block should track with Fifth Runback Value (RBV5). If more than one Runback commands are set, function block should track with the command that has lower Runback Value. 0: No Fifth Runback Control 1: Select Fifth Runback Control
FRBK	DINT	Force Back Address Input Receiving the Force Back address “FBA” from the next level’s controller. Empty this field as Disable.

Table 76 Runback Pin Input Parameters

Runback Pin Output Parameters

Name	Data Type	Description
AO	REAL	Runback Function Block Output
AMW	DINT	Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions table below for details.
FBA	DINT	Force Back Address FBA output the current function block Force Back address to the Force Back controlling target and it should connect to the “FRBK” field.
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 77 Runback Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
1	RUNBK_1	First Runback Command is set
2	RUNBK_2	Second Runback Command is set
3	RUNBK_3	Third Runback Command is set
4	RUNBK_4	Fourth Runback Command is set
5	RUNBK_5	Fifth Runback Command is set

6	ANY_RUNBK	Any Runback Command is set (When Runback command has expired the Holding Time without deselecting the Runback command, then it should be set.)
7	OUTLO	AO has reached the LO Limit
8	OUTHI	AO has reached the HI Limit
10	FORCEBACK	Restricted by the lower level ForceBack
13	INHM	Function Block is under Restricted, including: 1) ForceBack Restricted 2) Speed Rate Restricted 3) Upper and Lower Bounce Restricted
15	AUTO	Auto Mode
16	MANUAL	Manual Mode

Table 78 AMW Definitions

Runback Internal Parameters and Force Back

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter needs to access this function block. Default: 9
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (ST) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, ST could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO = Output Percentage*ACTO
STDR	REAL	Standard Rate When AO tracks with a Runback value, the output change rate should be set as either RATE or FAST. The output change rate selection depends on Runback Rate Type. Default: 0.1
FAST	REAL	Fast Rate When AO track with a Runback value, the output change rate should be set as either RATE or FAST. The output change rate selection is depending on Runback Rate Type. Default: 0.2
RBT1	BOOL	First Runback Rate Type

		When AO needs to track with a Runback Value, RBT1 might be used for rate choosing. RBT1 is corresponding with RBK1. 0: Using Standard Rate (RATE) 1: Using Fast Rate (FAST) [Default]
RBT2	BOOL	Second Runback Rate Type When AO needs to track with a Runback Value, RBT2 might be used for rate choosing. RBT2 is corresponding with RBK2. 0: Using Standard Rate (RATE) 1: Using Fast Rate (FAST) [Default]
RBT3	BOOL	Third Runback Rate Type When AO needs to track with a Runback Value, RBT3 might be used for rate choosing. RBT3 is corresponding with RBK3. 0: Using Standard Rate (RATE) 1: Using Fast Rate (FAST) [Default]
RBT4	BOOL	Fourth Runback Rate Type When AO needs to track with a Runback Value, RBT4 might be used for rate choosing. RBT4 is corresponding with RBK4. 0: Using Standard Rate (RATE) 1: Using Fast Rate (FAST) [Default]
RBT5	BOOL	Fifth Runback Rate Type When AO needs to track with a Runback Value, RBT5 might be used for rate choosing. RBT5 is corresponding with RBK5. 0: Using Standard Rate (RATE) 1: Using Fast Rate (FAST) [Default]
RBV1	REAL	First Runback Value When AO needs to track with a Runback Value, AO will track with the smallest value between PV and Runback Value. If more than one Runback Logical Input is set, it might need to compare with PV and/or other Runback Value to get the smallest value. RBV1 is corresponding with RBK1. Default: 90.0
RBV2	REAL	Second Runback Value When AO needs to track with a Runback Value, AO will track with the smallest value between PV and Runback Value. If more than one Runback Logical Input is set, it might need to compare with PV and/or other Runback Value to get the smallest value. RBV2 is corresponding with RBK2. Default: 70.0
RBV3	REAL	Third Runback Value When AO needs to track with a Runback Value, AO will track with the smallest value between PV and Runback Value. If more than one Runback Logical Input is set, it might need to compare with PV and/or other Runback Value to get the smallest value. RBV3 is corresponding with RBK3. Default: 50.0
RBV4	REAL	Fourth Runback Value When AO needs to track with a Runback Value, AO will track with the smallest value between PV and Runback Value. If more than one Runback Logical Input is set, it might need to compare with PV and/or other Runback Value to get the smallest

		value. RBV4 is corresponding with RBK4. Default: 30.0
RBV5	REAL	Fifth Runback Value When AO needs to track with a Runback Value, AO will track with the smallest value between PV and Runback Value. If more than one Runback Logical Input is set, it might need to compare with PV and/or other Runback Value to get the smallest value. RBV5 is corresponding with RBK5. Default: 10.0
HTIM	REAL	Holding Time Give a timer for Runback commands. This timer should start when AO has reached the lowest Runback Value (without exceed the OLL), then the AO should stay at this runback value for this amount of holding time. After the holding time expires, AO should track back with PV and will not take any Runback commands until all existing runback commands are cleared. The unit is seconds. Default: 60.0 (Track back with PV after 60 seconds)
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = MOP * ACTO + OSET Default: 100.0
OHL	REAL	Output HI limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OHL, it will trigger OUTHI alarm in AMW. Default: 1.0 Range: 0.0 ~ 1.0
OLL	REAL	Output LO limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OLL, it will trigger OUTLO alarm in AMW. Default: 0.0 Range: 0.0 ~ 1.0
OSR	REAL	Output Speed Rate OSR is controlling the output change rate. If the output value has been updated, then output value needs to be changed according to this OSR, instead of updating the output value immediately. Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: 1) Numerical Force Back (Value Tracking) will switch ON when the module is in both Manual and Auto Mode 2) Restricted Force Back (Set Limit) will switch ON when the module is under Auto Mode 0: Disable the Force Back 1: Enable the Force Back [Default]

FINS (REFERENCE ONLY)	DINT	Force Back Instance (Receive) A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output (Send Out) A variable that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit.
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage

Table 79 Runback Internal Parameters and Force Back

2.12.2 Description

2.12.2.1. Initialization (First Run)

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value should be set as the Manual Starting Value (MSV).

When STYP is TRUE, then the first cycle output value should set as the last output value. If the function block is the first run after the download, then output should be ZERO even if STYP is TRUE.

2.12.2.2. Select Manual or Automatic

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set as the Manual Output Percentage (MOP) of the Actual Project Output Range (ACTO), “e.g. AO = MOP * ACTO”. The user has the total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) should be set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range).

Note:

1) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.12.2.3. Standard Rate (RATE) and Fast Rate Setting (FAST)

When Runback Function Block Output (AO) needs to track with Runback Value, AO needs to be tracked with respect to a rate, either RATE or FAST. Output Speed Rate (OSR) will be disabled when either Rate or Fast is used. Runback gives options to the operator to choose the proper rate. If any one of the Runback Logical Input and its corresponding Rate Type are set, Fast Rate (FAST) will be used for Output (AO) tracking Runback Value; otherwise Standard Rate will be used.

2.12.2.4. Set Holding Time (HTIM)

HTIM is a period of time that allows the Runback Output (AO) to hold the Runback value. Once AO has reached the Runback value, a timer would start counting. The timer would not start when the Runback value exceeded the Output Low Limit (OLL).

For instance:
Runback receives a Runback Command. Runback Output (AO) starts tracking with that specific Runback Value within the output limit. Once AO reaches the Runback Value, the timer starts counting until it reaches the HTIM value. AO is maintained at the Runback value while the timer is counting. When the holding time is over, AO tracks back with PV and will not take another Runback Command until all existing Runback Commands are cleared.

2.12.2.5. Set Runback Force Back

This function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit).

1) Numerical Force Back (Value Tracking):
   - When Force Back Enable (FEN) is True under Manual Mode (MODE = False), the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
   - e.g. Current Force Back value = 40.0
     Upper level module output = 40.0
   - *Special Case (in Runback):
     Runback could send Numerical Force Back in Auto mode with Force Back Enable (FEN) under the following conditions:
     i. Have any Runback command
     ii. Tracking Runback value does not exceed the OLL
     iii. No Holding Time (HTIM = 0.0)
     iv. Have Force Back Enable (FEN = True)
     v. Operating in Auto mode

2) Restricted Force Back (Set Limit):
   - When Force Back Enable (FEN is True under Auto Mode (MODE = True) and the current function block output has reached the Output HI Limit (OHL) or Output LO Limit (OLL), the current function block will calculate a Force Back Blocking value and enforce a connected upper level module OHL or OLL to follow.
   - When the current function block receives a Restricted Force Back control from a lower level module, it will set the received value to its Output HI or LO Limit (OHL / OLL).
3) Warning:
   - Make sure the current Force Back Address (FBA) is connected to the Force Back control target.
   - Force Back Enable is only giving the current function block priority to choose between returning the Force Back control to the upper level or not. It is NOT giving the current function block authority to choose between accepting the Force Back control from the lower level or not.
   - *Special Case (in Runback):
     Runback OHL and OLL has the higher priority over the received Numerical Force Back control, if the received Force Back value has been exceeded the OHL or OLL.

2.12.2.6. Force Back Control Related Modules

The list below shows all modules that have Force Back Control functionality:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.12.2.7. Internal Parameters Default Values

The function block provides default values on the internal parameters convenient for collaboration. Here is the summary:

Name	Data Type	Default Value	Comments
FLAG [REFERENCE ONLY]	DINT	Address Identification Default: 90	Cannot be modified by operator
FUNT [REFERENCE ONLY]	DINT	Function Block Type Default: 9	Cannot be modified by operator
MSV	REAL	Manual Starting Value: Default: 0.0	Start the function block with MSV as output.
STYP	BOOL	Starting Type Default: 0	
MOP	REAL	Manual Output Percentage Default: None	
STDR	REAL	Standard Rate Default: 0.1	

FAST	REAL	Fast Rate Default: 0.2	
RBT1	BOOL	First Runback Rate Type Default: 1	Using Fast Rate
RBT2	BOOL	Second Runback Rate Type Default: 1	Using Fast Rate
RBT3	BOOL	Third Runback Rate Type Default: 1	Using Fast Rate
RBT4	BOOL	Fourth Runback Rate Type Default: 1	Using Fast Rate
RBT5	BOOL	Fifth Runback Rate Type Default: 1	Using Fast Rate
RBV1	REAL	First Runback Value Default: 90.0	
RBV2	REAL	Second Runback Value Default: 70.0	
RBV3	REAL	Third Runback Value Default: 50.0	
RBV4	REAL	Fourth Runback Value Default: 30.0	
RBV5	REAL	Fifth Runback Value Default: 10.0	
HTIM	REAL	Holding Time Default: 60.0	Track back with PV after 60 seconds
ACTO	REAL	Actual Project Output Range Default: 100.0	
OHL	REAL	Output HI limit Default: 1.0	Maximum 100% Range: 0.0 ~ 1.0
OLL	REAL	Output LO limit Default: 0.0	Minimum 0% Range: 0.0 ~ 1.0
OSR	REAL	Output Speed Rate Default: 0.05	Change at 5% per second
FEN	BOOL	Force Back Enable Default: 1	Start with Force Back Control

Table 80 Internal Parameters Default Values

2.12.2.8. General Example of Using Runback with DEB400

Runback provides a “Hard Runback” function when equipment suddenly receives an overload of energy. Runback has five Runback commands; it could provide the instant solution to an overload of energy from DEB400.

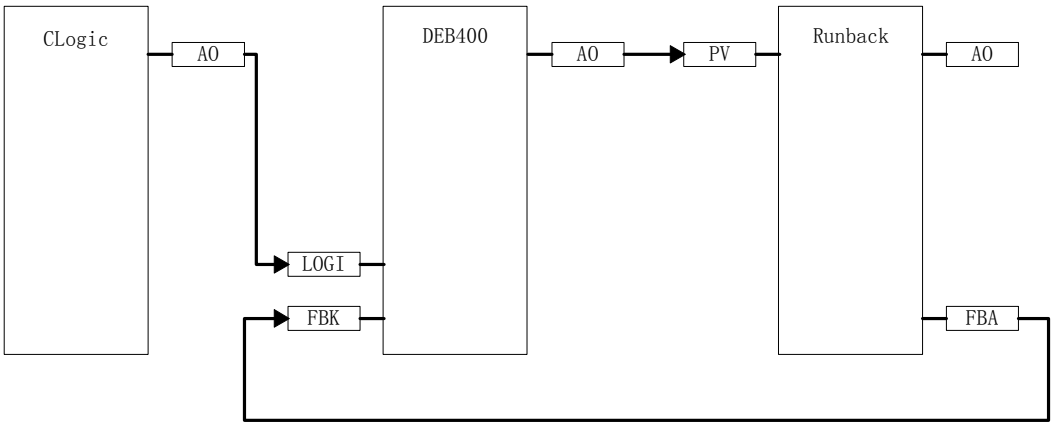


Figure 11 Settings of Using DEB400 with CLogic -> Runback

Note:

1) **Output Connections**: The CLogic output is connected to the DEB400 Common Logic Input (LOGI). The DEB400 output is connected to the Runback input PV.
2) **Force Back Connections**: The Runback force back output is connected to the DEB400 force back input.

2.13 DemandLimit

This “DemandLimit” function block mainly provides flow control service, usually on fuel, steam or water supply. When “DemandLimit” operates regularly, Output (AO) will track with input (Process Value, PV) according to its Output HI Limit (OHL), Output LO Limit (OLL) and Output Speed Rate (OSR). It has three Run Up and three Run Down inputs. When any of the Run Up or Run Down inputs is set, AO will be adjusted with respect to its selected speed rate for increase or decrease. In case more than one Run Up or Run Down inputs is set at the same time, Run Down will have the higher priority than Run Up. The difference between PV and AO cannot exceed the Max Error Permit (MERR) when manipulating run up or down command. Auto Mode Warning (AMW) will display each operation error. Each bit of AMW represents a different error message, for more details please read through the section, Function Block Parameters, in this document.

2.13.1 Operation Formula

Manual Mode Output Formula:

$$AO = MOP * ACTO$$

Note: AO = Function Block Output
MOP = Manual Output Percentage
ACTO = Actual Output Value

Auto Mode Output Formula:

$$AO <= PV + MERR - GAP$$
AND
$$AO >= PV - MER - GAP$$

Note: AO = Function Block Output
PV = Process Value
MERR = Max Error Value
GAP = Dead Band Value

2.13.2 Function Block Parameters

DemandLimit Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
PV	REAL	Process Value Process Value input. Default: 0.0
RUP1	BOOL	First Run Up Command Using First Restricted Speed Rate (SPR1) for output increase and not using Output Speed Rate (OSR). 0: Not Selected [Default] 1: Selected Note:

		1) Run Down has higher priority over Run Up commands 2) RDN3 has the highest priority in all Run Down commands. 3) RUP1 has the highest priority in all Run Up commands.
RUP2	BOOL	Second Run Up Command Using Second Restricted Speed Rate (SPR2) for output increase and not using Output Speed Rate (OSR). 0: Not Selected [Default] 1: Selected Note: 1) Run Down has higher priority over Run Up commands 2) RDN3 has the highest priority in all Run Down commands. 3) RUP1 has the highest priority in all Run Up commands.
RUP3	BOOL	Third Run Up Command Using Second Restricted Speed Rate (SPR2) for output increase and not using Output Speed Rate (OSR). 0: Not Selected [Default] 1: Selected Note: 1) Run Down has higher priority over Run Up commands 2) RDN3 has the highest priority in all Run Down commands. 3) RUP1 has the highest priority in all Run Up commands.
RDN1	BOOL	First Run Down Command Using Second Restricted Speed Rate (SPR2) for output decrease and not using Output Speed Rate (OSR). 0: Not Selected [Default] 1: Selected Note: 1) Run Down has higher priority over Run Up commands 2) RDN3 has the highest priority in all Run Down commands. 3) RUP1 has the highest priority in all Run Up commands.
RDN2	BOOL	Second Run Down Command Using Second Restricted Speed Rate (SPR2) for output decrease and not using Output Speed Rate (OSR). 0: Not Selected [Default] 1: Selected

		Note: 1) Run Down has higher priority over Run Up commands 2) RDN3 has the highest priority in all Run Down commands. 3) RUP1 has the highest priority in all Run Up commands.
RDN3	BOOL	Third Run Down Command Using First Restricted Speed Rate (SPR1) for output decrease and not using Output Speed Rate (OSR). 0: Not Selected [Default] 1: Selected Note: 1) Run Down has higher priority over Run Up commands 2) RDN3 has the highest priority in all Run Down commands. 3) RUP1 has the highest priority in all Run Up commands.
COUT	BOOL	Cutout Cutout all the Run Up or Down Command. 0: Function Block takes any Run Up or Down Command [Default] 1: Cutout all the Run Up or Down Command even any command is set.
FRBK	DINT	Force Back Address Input Receiving the Force Back address “FBA” from the next level’s controller. Empty this field as Disable.

Table 81 DemandLimit Pin Input Parameters

DemandLimit Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output Function block controlled value output
AMW	DINT	Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions Table below for details.
FBA	DINT	Force Back Address FBA output the current function block Force Back address to the Force Back controlling target and it should connect to the “FRBK” field
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 82 DemandLimit Pin Output Parameters

AMW Definitions

Bit Position	Definition	Description
1	B_RUNUPDN	Boiler Run Up & Down Command
2	B_RUNUP	Boiler Run Up Command
3	B_RUNDN	Boiler Run Down Command
4	T_RUNUPDN	Turbine Run Up & Down Command
5	T_RUNUP	Turbine Run Up Command
6	T_RUNDN	Turbine Run Down Command
7	OUTLO	AO has reached the LO Limit
8	OUTHI	AO has reached the HI Limit
10	FORCEBACK	Restricted by the lower level ForceBack
13	INHM	Function Block is under Restricted, including ForceBack Restricted, Speed Rate Restricted, Upper and Lower Bounce Restricted
15	AUTO	Auto Mode
16	MANUAL	Manual Mode

Table 83 AMW Definitions

DemandLimit Internal Parameters and Force Back

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter need to access this function block. Default: 10
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (ST) is 0 Default: 0.0
STYP	BOOL	Starting Type After the function block is paused or stopped, ST could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode e.g. AO=Output Percentage*ACTO
SPR1	REAL	First Restricted Speed Rate This is one of the operation rates when First Run Up (RUP1) or Third Run Down (RDN3) is set. Default: 0.2 (20% per second) Note: If either SPR1 or SPR2 is used, OSR will not affect the real time output.
SPR2	REAL	Second Restricted Speed Rate This is one of the operation rates when Second or Third Run Up (RUP2 or RUP3) or First or Second Run Down (RDN1 or RDN2) is set.

		Default: 0.1 (10% per second) Note: If either SPR1 or SPR2 is used, OSR will not affect the real time output.
GAP	REAL	Dead Band Value When the output value (AO) is within the range of dead band, the status of Turbine's alarm (in AMW) could not be changed. Turbine's alarm means "T_RUNUPDN", "T_RUNUP" and "T_RUNDN". (See *Function Block Description* for more details.) Default: 5.0 Warning: Dead Band Range should be smaller than Max Error value.
MERR	REAL	Max Error Value The deviation, between input value (PV) and output value (AO), should not exceed this MERR. Otherwise the maximum or minimum output value should be PV plus or minus MERR. Default: 15.0 Note: Dead Band Range value should be smaller than Max Error value.
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = MOP * ACTO Default: 100.0
OHL	REAL	Output HI limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OHL, it will trigger OUTHI alarm in AMW. Default: 1.0 Note: OHL range should be 0.0 ~ 1.0
OLL	REAL	Output LO limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OLL, it will trigger OUTLO alarm in AMW. Default: 0.0 Note: OLL range should be 0.0 ~ 1.0
OSR	REAL	Output Speed Rate OSR is controlling the output change rate. If the output value has been updated, then output value needs to be changed according to this OSR, instead of updating the output value immediately. Unit is % per second; Default: 0.05 (5% per second)
FEN	BOOL	Force Back Enable Once this FEN is TRUE: 1) Numerical Force Back (Value Tracking) will switch ON when the module is in both Manual and Auto Mode 2) Restricted Force Back (Set Limit) will switch ON when the module is under Auto Mode

		0: Disable the Force Back 1: Enable the Force Back [Default]
FINS (REFERENCE ONLY)	DINT	Force Back Instance (Receive) A variable that shows the type of Force Back receiving. 0: No Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT (REFERENCE ONLY)	DINT	Force Back Output (Send Out) A variable that shows the type of Force Back sending. 0: NO Force Back Receiving 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.
FINC (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit
FDEC (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that receives from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage
RSV2	DINT	32 bits reserved Force Back parameter for later usage

Table 84 DemandLimit Internal Parameters and Force Back

2.13.3 Description

2.13.3.1. Initialization (First Run)

Under the situation when the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value should be set as the Manual Starting Value (MSV).

When STYP is TRUE, then the first cycle output value should be set as the last output value. If the function block is the first run after the download, then output should be ZERO even when STYP is TRUE.

2.13.3.2. Select Manual or Automatic

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will set as the Manual Output Percentage (MOP) of Actual Project Output Range (ACTO). “e.g. AO = MOP * ACTO” The operator has total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) should be set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range).

Note: When MODE has switched from Auto to Manual mode, AO should retain as the last Auto mode output.

Note:

When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.13.3.3. Set Restricted Speed Rate (SPR1 & SPR2)

DemandLimit provides three Run Up and three Run Down commands. Run Up 1 (RUP1) and Run Down 3 (RDN3) use SPR1 and the rest of the Run Up and Down commands use SPR2. SPR1, SPR2 and OSR have equal priority on effecting output speed rate when either one is selected.

2.13.3.4. Set Cutout (COUT)

Cutout (COUT) has the control in Auto mode only. When COUT is False, the function block output (AO) should track with the Run Up or Run Down commands according to the Max Error Value (MERR). When COUT is TRUE with the condition of no received Force Back Control in Auto mode, AO should track with the Process Value (PV). COUT has the control over all Run Up and Run Down commands.
e.g. AO <= PV + MERR – GAP
AND
AO >= PV – MERR + GAP

Warning:

I) If DemandLimit starts with a Run Down command and without a proper initial value (the initial output value is smaller than the expected output), the first cycle output value may change without referencing the OSR.

a. The following settings might occur to the problem described above:

Variable Name	Type	Value (Empty means using the default value)
EN	BOOL	True
MODE	BOOL	True (Auto)
PV	REAL	50.0
RUP1	BOOL	
RUP2	BOOL	
RUP3	BOOL	
RDN1	BOOL	True
RDN2	BOOL	
RDN3	BOOL	
COUT	BOOL	

FRBK	DINT	-1
DemandLimit Internal Parameters		
MSV	REAL	0.0
STYP	BOOL	False
MOP	REAL	
SPR1	REAL	0.05
SPR2	REAL	0.01
GAP	REAL	5.0
MERR	REAL	15.0
ACTO	REAL	100.0
ILMT	BOOL	
DLMT	BOOL	
OHL	REAL	1.0
OLL	REAL	0.0
OSR	REAL	0.05
FEN	BOOL	

b. Result: AO might jump to 35.0 immediately without OSR control when the function block is enabled.

2.13.3.5. Set Dead Band Value (GAP)

The purpose of using dead band in DemandLimit is to avoid the oscillations of Turbine's alarms in AMW. When the output value (AO) exceeds the Max Error value (MERR), Turbine's alarms will be set. If the output value oscillates near the MERR line, it could cause the Turbine's alarms to switch between "ON" and "OFF". The operator might not be able to trust the authenticity of the oscillated alarms in AMW, so DemandLimit needs a dead band to solve the oscillation problem. The dead band is placed in different locations when DemandLimit operates with different commands. The following graphs show the different locations of the dead band:

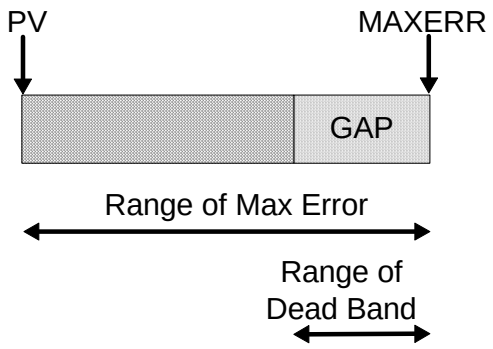


Figure 12 DemandLimit Operates in RunUp Command

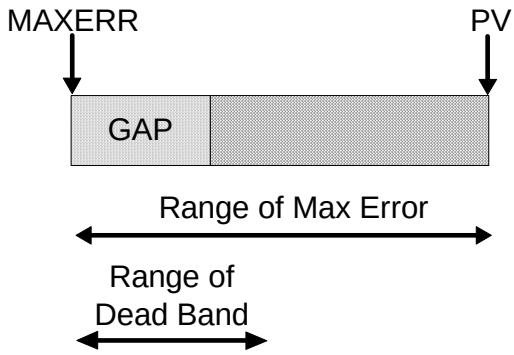


Figure 13 DemandLimit Operates in RunDown Command

2.13.3.6. Set DemandLimit Force Back

This function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit).

1) Numerical Force Back (Value Tracking):
   - When Force Back Enable (FEN) is True under Manual Mode (MODE = False), the current function block will calculate a Force Back value and enforce a connected upper level module output to follow.
     - e.g. Current Force Back value = 40.0
       Upper level module output = 40.0
     - *Special Case (in DemandLimit):
       When Force Back Enable (FEN) is True under Auto Mode (MODE = True) with no restriction on listening any Run Up or Run Down command (means No Cutout), the current function block should calculate a Force Back value and enforce the connected upper level module output to follow.

2) Restricted Force Back (Set Limit):
   - When Force Back Enable (FEN is True under Auto Mode (MODE = True) and the current function block output has reached the Output HI Limit (OHL) or Output LO Limit (OLL), the current function block will calculate a Force Back Blocking value and enforce a connected upper level module OHL or OLL to follow.
   - *Special Case (in DemandLimit):
     When current function block received Restricted Force Back control from lower level module, it will set the received value to its Output HI or LO Limit (OHL / OLL) if the received value is not equal to or exceeds the limit of PV + MERR or PV - MERR. Otherwise the current function block should export the value of PV + MERR or PV – MERR as its output.

3) Warning:
   - Make sure that the current Force Back Address (FBA) is connected to the Force Back control target.
   - Force Back Enable only gives the current function block priority to choose between return the Force Back control to the upper level or not. It is NOT giving the current function block authority to choose between the accepted the Force Back control from the lower level or not.
   - *Special Case (in DemandLimit):
     If the received Restricted Force Back value is equal to or exceeds the value of PV + MERR or PV – MERR, the lower level module may not receive the usual Force Back Control value.

2.13.3.7. Force Back Control Related Modules

The list below shows all modules that have Force Back Control functionality:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.13.3.8. Internal Parameters Default Values

The function block provides default values on the internal parameters convenient for collaboration. Here is the summary:

Name	Data Type	Default Value	Comments
FLAG [REFERENCE ONLY]	DINT	Address Identification Default: 90	Cannot be modified by operator
FUNT [REFERENCE ONLY]	DINT	Function Block Type Default: 10	Cannot be modified by operator
MSV	REAL	Manual Starting Value: Default: 0.0	Start the function block with MSV as output.
STYP	BOOL	Starting Type Default: 0	
MOP	REAL	Manual Output Percentage Default: None	Depends on MSV setting
SPR1	REAL	First Restricted Speed Rate Default: 0.2	Change at 20% per second Note: If either SPR1 or SPR2 is used, OSR will not affect the real time output.
SPR2	REAL	Second Restricted Speed Rate Default: 0.1	Change at 10% per second Note: If either SPR1 or SPR2 is used, OSR will not affect the real time output.
GAP	REAL	Dead Band Value Default: 5.0	Warning: Dead Band Range should be smaller than Max Error value.
MERR	REAL	Max Error Value Default: 15.0	Note: Dead Band Range value should be smaller than Max Error value.
ACTO	REAL	Actual Project Output Range Default: 100.0	
OHL	REAL	Output HI limit Default: 1.0	Maximum 100% Note: OHL range should be 0.0 ~ 1.0
OLL	REAL	Output LO limit Default: 0.0	Minimum 0% Note: OLL range should be 0.0 ~ 1.0
OSR	REAL	Output Speed Rate Default: 0.05	Change at 5% per second
FEN	BOOL	Force Back Enable	Start with Force Back

		Default: 1	Control

Table 85 Internal Parameters Default Values

2.13.3.9. General Example of Using DemandLimit with DEB400 and Participation

Since DemandLimit has independent ability to increase or decrease the output value (using Run Up and Run Down commands) within a safe range (using MERR), it could be placed after Participation for giving equipment demand as shown in the following diagram:

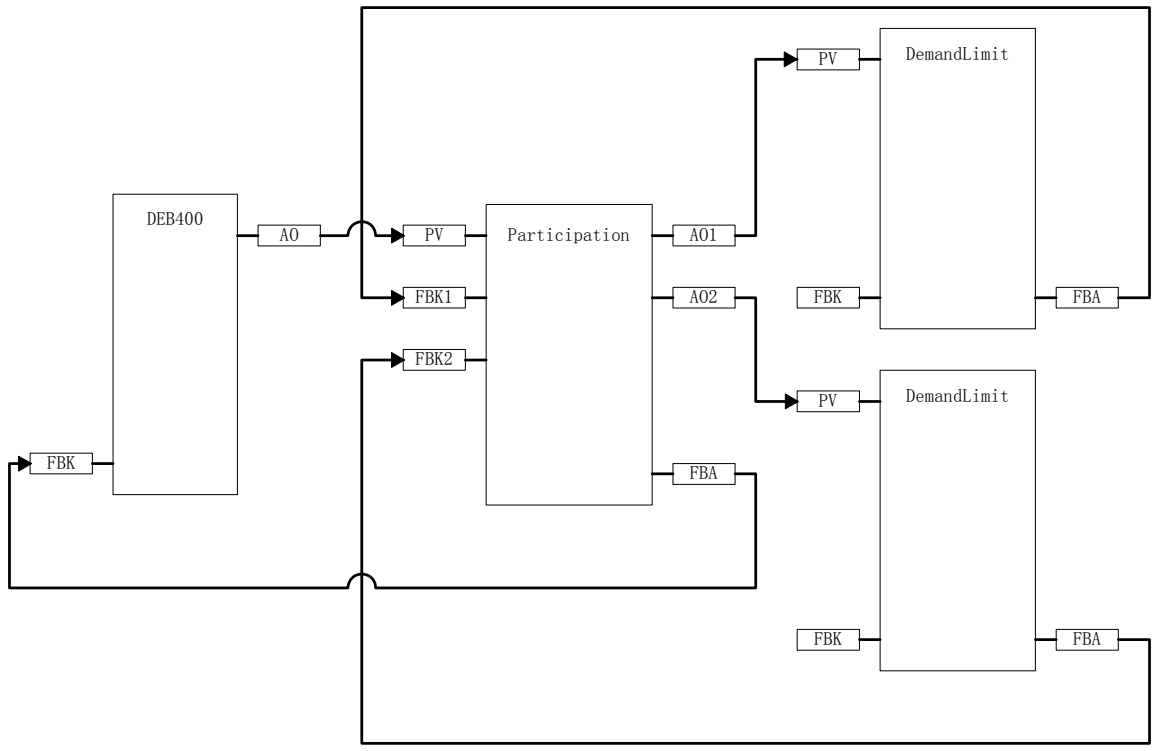


Figure 14 Settings of Using DEB400 -> Participation -> DemandLimit

Note:

1) Output Connections: DEB400 output is connected to Participation input (PV). Participation output (AO1 & AO2) is connected to different DemandLimit inputs (PV).
2) Force Back Connections: DemandLimit force back output is connected to Participation force back input. Participation force back output is connected to DEB400 force back input.

2.14 DEB400

This “DEB400” function block provides a unique and proven approach to the control and coordination of the turbine with the boiler. The coordinated boiler-turbine control system is a key element in the operation of large modern fossil-fueled steam-electric generating stations.

The function block utilizes special algorithms designed for header pressure control. DEB400 could stabilize a coordinated boiler-turbine control system through balancing the steam engine’s thermal energy input (demand) and boiler energy output (supply).

“DEB400” provides the Common Logic input (from the CLogic function block), Auto Mode Warning (AMW) and Force Back control for better control and monitoring.

2.14.1 Operation Formula

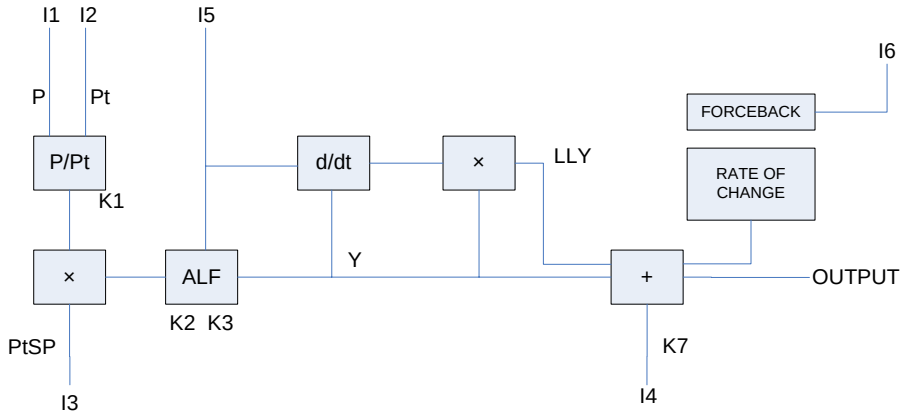


Figure 15 DEB400 Operation

Operation Formula:

$$Output = Y + Z + K7 * I4 + Y * \frac{(Y * sK5)}{(Y * sK6)}$$

Note:

I1	[P1], First Stage Pressure
I2	[PT], Throttle Pressure
I3	[PS], Throttle Pressure Set Point
I4	[PSRT], Pressure Set Point Rate
I5	[INI], Initialization
I6	[CFBK], Force Back Cancellation
K1	[P1R], First Stage Pressure Ratio
K2	[ALFB], ALF Bandwidth
K3	{ALFT], ALF Time
K4	[BALT], Internal Balance Time
K7	[PSR], Differential Gain Time of Pressure Set Point

2.14.2 Parameters

DEB400 Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual [Default] 1: Auto
P1	REAL	First Stage Pressure Default: 0.0
PT	REAL	Throttle Pressure Default: 0.0
PTSP	REAL	Throttle Pressure Set Point Default: 0.0
PSRT	REAL	Pressure Set Point Rate Default: 0.0
INI	BOOL	Initialization Reset Internal variables. When INI is set, ALF loop filter, Gain Time of Dynamic Compensation (LEAD), Differential Gain Time of Dynamic Compensation (LAG) and Internal Balance Time (BALT) would not effect on output calculation. 0: Continues with current process [Default] 1: Reset internal variables.
CFBK	BOOL	Force Back Cancellation DEB400 could deny all kinds of received Force Back control. 0: Accept Force Back control [Default] 1: Deny Force Back control
TKVA	REAL	Tracking Value Output value will set as this Tracking Value when Tracking Switch (TKSW) is TRUE. Default: 0.0
TKSW	BOOL	Tracking Switch Force the current function block to operate in Manual mode and track with Tracking Value (TKVA). TKSW could operate in both Manual and Auto mode. 0: Continues with current process [Default] 1: Output tracks with TKVA.
GOPS	BOOL	Go Preset Switch Force the current function block to track with PSET in Auto mode. Function block would ignore this command in Manual mode. 0: No Preset [Default] 1: Set output as Pre-Set value (PSET)
LOGI	DINT	Common Logic Input DEB400 has 13 conditional inputs as Common Logic Inputs Please check the following LOGI Definition

		table.
FRBK	DINT	Force Back Address Input Receive the Force Back address “FBA” from the next level’s controller. Empty this field as Disable.

Table 86 DEB400 Pin Input Parameters

DEB400 Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output Function block controlled value output
LOGO	DINT	Common Logic Status Output This is a 32-bits output that shows the logic status.
AMW	DINT	Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions table below for details.
FBA	DINT	Force Back Address FBA outputs the current function block Force Back address to the Force Back controlling target and it should connect to the “FRBK” field.
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 87 DEB400 Pin Output Parameters

LOGI Definitions

Definition	Description
XF	Exchange Failure
ABLK	Auto Mode Blocking
IBLK	Increment Blocking
DBLK	Decrement Blocking
IOVR	Increment Override
DOVR	Decrement Override
MOVR	Manual Mode Override
ROVR	Speed Rate Override
PCAN	Cancel Participation
ILMT	Reach Increment Limit
DLMT	Reach Decrement Limit
ASUS	Auto Suspension
LOCO	Local Controlling
ACK	Alarm Acknowledge
MODE	LSDP Mode

Table 88 LOGI Definitions

AMW Definitions

Bit Position	Definition	Description
7	OUTLO	AO has reached the LO Limit
8	OUTHI	AO has reached the HI Limit
9	GO_PRESET	Go Preset Switch is TRUE
10	FORCEBACK	Restricted by the lower level ForceBack
13	INHM	Function Block is under Restricted, including ForceBack Restricted, Speed Rate Restricted, Upper and Lower Bounce Restricted
15	AUTO	Auto Mode
16	MANUAL	Manual Mode

Table 89 AMW Definitions

DEB400 Internal Parameters and Force Back

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter needs to access this function block. Default: 11
MSV	REAL	Manual Starting Value: Set the function block First Run output value with this MSV when the Starting Type (STYP) is 0.
STYP	BOOL	Starting Type After the function block is paused or stopped, STYP could control the restart output value with reset or keep the last setting. 0: Start the function block with reset output [Default] 1: Continue with the last output value
MOP	REAL	Manual Output Percentage User could set the Output Percentage, when the function block is in Manual mode. e.g. AO=Output Percentage*ACTO
P1R	REAL	First Stage Pressure Ratio Default: 1.0
ALFB	REAL	ALF Bandwidth Default: 0.2 Warning: Have to be a positive number.
ALFT	REAL	ALF Time Loop filter Time. Unit is Second. Default: 1.0 second
BALT	REAL	Internal Balance Time Gives DEB400 a period of time to balance the output when the function block gets back the total control from Increase Override, Decrease Override, Manual Override, Go Preset mode, or Numerical Force Back control. Unit is second.

		Default: 1.0 second
LEAD	REAL	Gain Time of Dynamic Compensation Default: 1.0 second
LAG	REAL	Differential Time of Dynamic Compensation Default: 1.0 second
PSR	REAL	Differential Gain Time of Pressure Set Point Default: 1.0
PSET	REAL	Preset Value When GOPS is set in Auto mode, output should track with PSET. Default: 0.0
ACTO	REAL	Actual Project Output Range ACTO is the maximum value of a project output range e.g. AO = MOP * ACTO Default: 100.0
OHL	REAL	Output HI limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OHL, it will trigger OUTHI alarm in AMW. Default: 1.0
OLL	REAL	Output LO limit When the Output Percentage (same as MOP but in Auto Mode) has reached this OLL, it will trigger OUTLO alarm in AMW. Default: 0.0
OSR	REAL	Output Speed Rate OSR is controlling the output change rate. If the output value has been updated, then output value needs to be changed according to this OSR, instead of updating the output value immediately. Unit is % per second; Default: 0.05 (5% per second)
FINS (REFERENCE ONLY)	DINT	Force Back Instance (Receive) A variable that shows the type of received Force Back. 0: No Force Back Received 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FOUT [N/A] (REFERENCE ONLY)	DINT	Force Back Output (Send Out) A variable that shows the type of Force Back sending. 0: No Force Back Received 1: Force Back Increase Blocking (Limit) 2: Force Back Decrease Blocking (Limit) 4: Force Back Tracking
FVLU [N/A] (REFERENCE ONLY)	REAL	Force Back Value (Send Out) It is a Force Back Tracking value that upper level module needs to be tracked with.

FINC [N/A] (REFERENCE ONLY)	REAL	Force Back Increase Blocking Value (Send Out) This value sends to the upper level module for noticing the expected output high limit.
FDEC [N/A] (REFERENCE ONLY)	REAL	Force Back Decrease Blocking Value (Send Out) This value sends to the upper level module for notifying the expected output low limit.
FIIV (REFERENCE ONLY)	REAL	Force Back Input Increment Value (Receive) This value receives from the lower level module for notifying that the output should not exceed FIIV.
FIDV (REFERENCE ONLY)	REAL	Force Back Input Decrement Value (Receive) This value receives from the lower level module for notifying that the output should not be lower than FIDV.
FIV (REFERENCE ONLY)	REAL	Force Back Input Value (Receive) It is a Force Back Tracking value that is received from the lower level module.
FID (REFERENCE ONLY)	DINT	Selected Function Block Force Back ID (Send Out) It is “Switch” input selected function block ID.
FIID (REFERENCE ONLY)	DINT	Selected Function Block Force Back Input ID (Receive) It is “Switch” input selected function block ID. This parameter is used when current function block output is providing “Switch” an input value.
RSV1	DINT	32 bits reserved Force Back parameter for later usage
RSV2	DINT	32 bits reserved Force Back parameter for later usage

Table 90 DEB400 Internal Parameters and Force Back

2.14.3 Description

2.14.3.1. Initialization (First Run)

Under the situation where the Function Block is FIRST RUN, if the Starting Type (STYP) is FALSE, then the first cycle output value should be set as the Manual Starting Value (MSV).

When STYP is TRUE, then the first cycle output value will be set as the last output value. If the current starting is a brand new starting, when STYP is TRUE, the FIRST RUN output value will be ZERO.

2.14.3.2. Select Manual or Automatic

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the output (AO) will be set as the Manual Output Percentage (MOP) of Actual Project Output Range (ACTO), “e.g. AO = MOP * ACTO”. The user has total output control by adjusting MOP when it has no received Force Back Tracking.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the output (AO) should set as the formula calculation result when there is no received Force Back control and no kinds of restrictions (Exceed Output HI / LO Range).

Note:

1) When MODE has switched from Auto to Manual mode, AO will retain as the last Auto mode output.
2) When MODE has switched from Manual to Auto mode and the Manual mode AO has already exceeded the Output HI / LO Range, AO will start at the Output HI / LO Limit (OHL / OLL) immediately then continue tracking the formula calculation result.

2.14.3.3. Set DEB400 Force Back

This function block has two kinds of Force Back: Numerical Force Back (Value Tracking) and Restricted Force Back (Set Limit). However DEB400 only receives Force Back control from lower level module and would not give out any Force Back Control to upper level module.

1) Numerical Force Back (Value Tracking):
   - No Numerical Force Back receiving in Manual mode.
   - When function block receives Numerical Force Back control from lower level module in Auto mode, its output should trace with the received Force Back value.
     e.g. Received Numerical Force Back value = 40.0
     Current Output = 40.0

2) Restricted Force Back (Set Limit):
   - No Restricted Force Back receiving in Manual mode.
   - When function block receives Restricted Force Back control from lower level module in Auto mode, its output limit (OHL/OLL) should temporarily update with respect to the type of Restricted Force Back.

3) Special Feature (Force Back Cancellation):
   - DEB400 has authority to deny receiving Force Back Control from lower level module.
   - DEB400 does not have Force Back Enable (FEN), so it would not give out any Force Back Control to upper level module.

4) Warning:
   - Make sure function block has the proper Force Back connection. Connected Force Back Address Input (FRBK) to Force Back Address (FBA).
   - When CFBK is set, DEB400 could deny all kinds of Force Back control from lower level module.

2.14.3.4. Common Logic Input & Output

The Common Logic Input (LOGI) has 13 input fields:
Exchange Failure (**XF**), Auto Mode Blocking (**ABLK**), Increment Blocking (**IBLK**), Decrement Blocking (**DBLK**), Increment Override (**IOVR**), Decrement Override (**DOVR**), Manual Mode Override (**MOVR**), Speed Rate Override (**ROVR**), Cancel Participation (**PCAN**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Suspend (**ASUS**), Local Controlling (**LOCO**), Alarm Acknowledge (**ACK**), LSDP Mode (**MMOD**)

The Common Logic Output (LOGO) has 22 output fields:
Alarm (**ALARM**), Exchange Failure (**XF**), Increment Release (**IRLS**), Decrement Release (**DRLS**), Feed Back Failure (**FBF**), Increment Override (**IOVRD**), Decrement Override (**DOVRD**), Cancel Participation (**PCAN**), Automatic Release (**ARLS**), Drive Unit Failure (**DUF**), Auto Loss (**ALOSS**), Auto Trapped (**ATRPD**), Reach Increment Limit (**ILMT**), Reach Decrement Limit (**DLMT**), Auto Inhibit (**AINH**), Auto Mode (**AUTO**), Local Controlling (**LOCAL**), Partition Froze (**PATF**), Rebalance (**RBAL**), Cutout Exceeds Limit (**XCSCO**), Acknowledge (**ACK**), LSDP Mode (**MMOD**)

Note:
Please see the CLogic specification for more details.

2.14.3.5. Common Logic Input – Manual Override (MOVR)

MOVR is one of the Common Logic Inputs. The DEB400 Output (AO) value should be locked at the current value when MOVR is set. DEB400 operation mode should maintain auto control.

Special Cases:

1) DEB400 is in Manual mode, Function Block Operation Mode (MODE) is FALSE.
2) DEB400 is in Tracking Value mode (Tracking Switch, TKSW, is TRUE)
3) DEB400 is in Go Preset mode (Go Preset Switch, GOPS, is TRUE)

2.14.3.6. Common Logic Input – Increase & Decrease Override (IOVR & DOVR)

When Increase Override (IOVR) is TRUE, the Output (AO) will track with Output HI Limit (OHL) in both Manual and Auto mode.
When Decrease Override (DOVR) is TRUE, AO will track with the Output LO Limit (OLL) in both Manual and Auto mode.

Special Case:

1) When both IOVR and DOVR are TRUE in Auto mode, IOVR should have higher priority than DOVR and would not set MOVR in DEB400.
2) When both IOVR and DOVR are TRUE in Manual mode, DOVR should have higher priority than IOVR.

2.14.3.7. Common Logic Input – Speed Rate Override (ROVR)

Speed Rate Override is one of the Common Logic Inputs. When ROVR is set to TRUE, the output should not be changed according to the Output Speed Rate (OSR).
Please consider the following situations that ROVR might or might not function in Switch:

1) When AO is changing in Tracking Value mode (Tracking Switch, TKSW is TRUE), ROVR might function.
2) When AO is changing in Go Preset mode (Go Preset Switch, GOPS, is TRUE), ROVR might function.
3) When AO is changing in Increase or Decrease Override (IOVR or DOVR is TRUE), ROVR might function.

2.14.3.8. Common Logic Input – Auto Suspend (ASUS)

ASUS authorizes the module to remain in auto mode operation in case of loss of Auto mode control.

For instance:
When DEB400 receives only XF from Common Logic module, DEB400 should operate in Manual mode and its Common Logic Status Output (LOGO) should have Alarm, XF, ALOSS and ATRAP. If DEB400 receives only XF and ASUS from Common Logic module, DEB400 should maintain to operate in Auto mode and its LOGO should have Alarm, XF and ALOSS only.

Note:

AMW should show user that module is still operating under auto mode, but LOGO should not show.

2.14.3.9. Common Logic Input – Alarm Acknowledge (ACK)

The Alarm Acknowledge parameter gives the operator authority to reset the Alarm on the Common Logic Output. The function block will only manage this ACK command once, when ACK is set to TRUE. If an operator wants to reset the Alarm a second time, ensure to reset the ACK command before giving the request again.

2.14.3.10. Set Auto Mode Warning (AMW)

Auto Mode Warning (AMW) mainly provides a service in Auto mode to let the operator know the function block's most up-to-date status. Switch shows seven kinds of conditions, they are:

- OUTLO
- OUTHI

- GO_PRESET
- FORCEBACK
- INHM
- AUTO
- MANUAL

OUTLO is set when AO has reached the Output Lo Limit. As a reminder: AO = OP * ACTO and the Output High/Low Limit is compared with the Operation Percentage (same as MOP in Auto mode).
OUTHI is set when AO has reached the Output Hi Limit. As a reminder: AO = OP * ACTO and the Output High/Low Limit is compared with the Operation Percentage (same as MOP in Auto mode).
GO_PRESET is set when the function block traces with the Preset Value in Auto mode.
FORCEBACK is set when the function block has received any Force Back control from a lower level module.
INHM is set when the function block has the following conditions:

- ForceBack Restricted (When the function block has received Force Back control in Auto mode)
- Speed Rate Restricted (When Output is increasing or decreasing, the speed rate has exceeded the OSR)
- Upper and Lower Bounce Restricted (Output has reached the Output High/Low Limit)
- Common Logic Restriction (when Decrease Override, Increase Override, or Manual Override is set in Common Logic Input).

AUTO is set when the function block is under Automatic mode
MANUAL is set when the function block is under Manual mode

2.14.3.11. Force Back Control Related Modules

The list below shows all modules that have Force Back Control functionality:

1) Addition
2) DEB400
3) DemandLimit
4) Divider
5) LeadLag
6) Multiply
7) Participation
8) PID
9) Runback
10) Servo
11) Switch

2.14.3.12. General Example of Using DEB400, Participation and DemandLimit

DEB400 could give a control value to one or more pieces of equipment. In the following example, DEB400 has Participation as its complement function block to supply two DemandLimit input values.

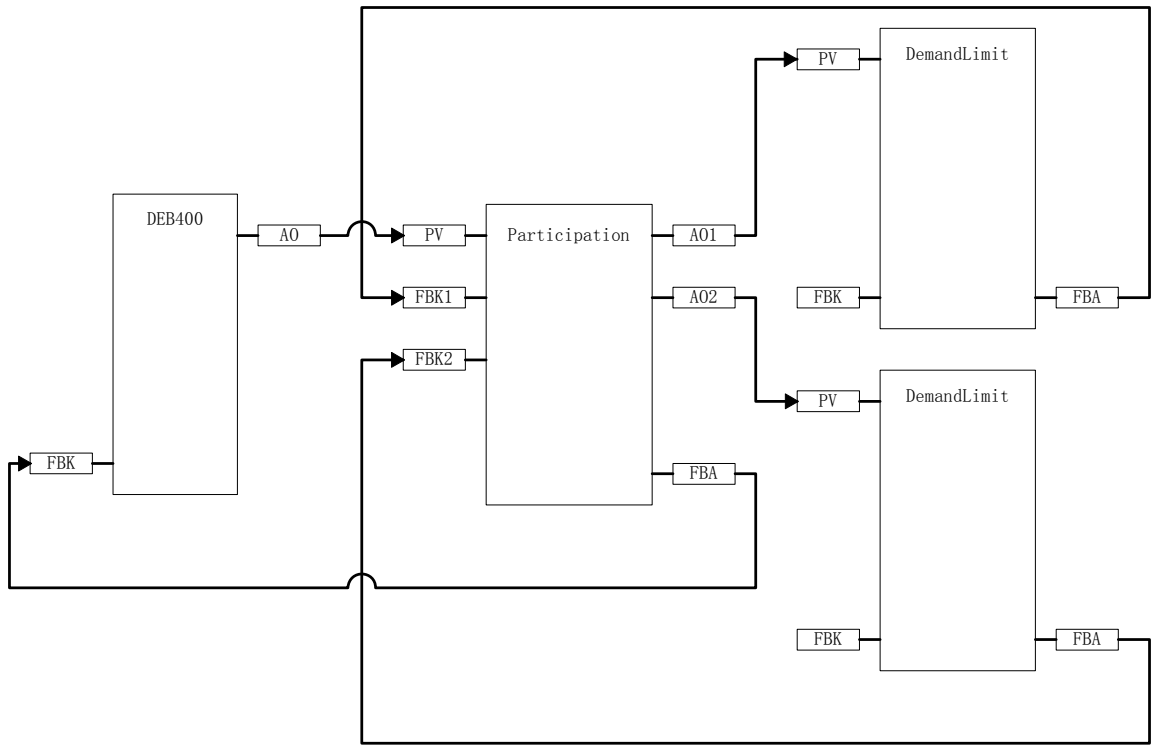


Figure 16 Settings of Using DEB400 -> Participation -> DemandLimit

Note:

1) Output Connections: DEB400 output is connected to Participation input (PV). Participation output (AO1 & AO2) is connected to two different DemandLimit inputs (PV).
2) Force Back Connections: DemandLimit force back output is connected to Participation force back input. Participation force back output is connected to DEB400 force back input.

2.14.3.13. General Example of Using DEB400 with Common Logic and Runback

DEB400 provides a unique approach to the control and coordination of the turbine with the boiler. Runback could provide the instant solution on an overload energy from DEB400.

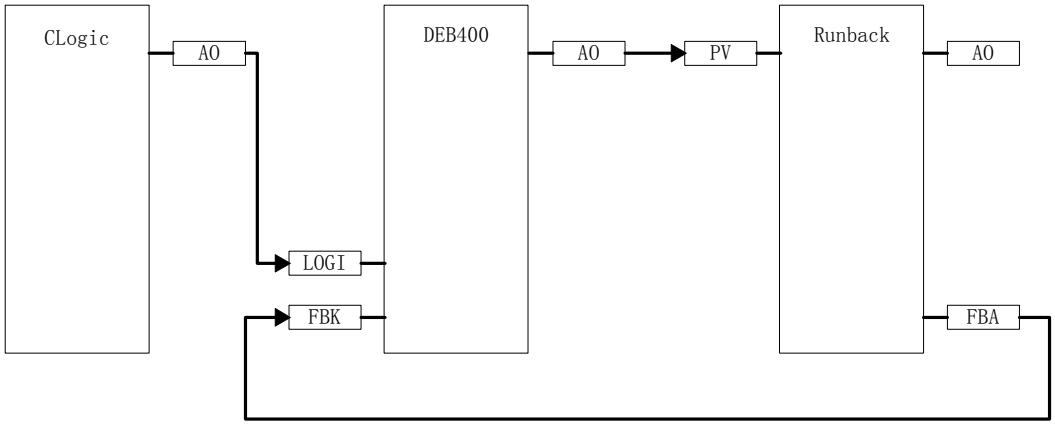


Figure 17 Settings of Using DEB400 with CLogic -> Runback

Note:

1) **Output Connections**: CLogic output is connected to DEB400 Common Logic Input (LOGI). DEB400 output is connected to Runback input PV.
2) **Force Back Connections**: Runback force back output is connected to DEB400 force back input.

2.15 SEL2

This “SEL2” function block is dedicated to those devices with a redundancy output and need to export to a device with single-input only. It has manual and auto operation mode. This function block provides three output selection commands in Auto mode. Those commands are “Select High”, “Select Low” and “Average”. The function block provides two output selection commands in Manual mode. Those commands are, “Select first input value” & “Select second input value”.

2.15.1 Parameters

SEL2 Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual mode [Default] 1: Auto mode
MANU	BOOL	Manual Mode Output Options When the operation mode is “Manual”, operator could freely select output value. 0: Select First Input Value [Default] 1: Select Second Input Value
AUTO	SINT	Auto Mode Output Options When the operation mode is “Auto”, operator could have more flexible options. 0: Select the Low value [Default] 1: Select the High value 2: Select the Average
VLU1	REAL	First Input Value This is the first input value. Default: 0.0
ST1	BOOL	First Input Status It shows “VLU1” connected device communication link status. 0: Device Communication Connecting. [Default] 1: Device Communication Failure. Warning: Manual Mode -- When the selected input value has device communication link failure, Output Status “OUTS” should be set to notify operator and output should keep the last output value with respect to the selection. For example: If the current selection is selecting the first input value, but the first input status is set, then the function block should export the last succeeded output value of the first input value. Auto Mode -- When both “ST1” & “ST2” have device communication link failure status, Output Status “OUTS” should be set

		to notify operator and output should keep the last output value.
VLU2	REAL	Second Input Value This is the second input value. Default: 0.0
ST2	BOOL	Second Input Status It shows “VLU2” connected device communication link status. 0: Device Communication Connecting. [Default] 1: Device Communication Failure. Warning: Manual Mode -- When the selected input value has device communication link failure, Output Status “OUTS” should be set to notify operator and the output should keep the last output value with respect to the selection. For example: If the current selection is selecting the first input value, but the first input status is set, then function block should export the last succeeded output value of the first input value. Auto Mode -- When both “ST1” & “ST2” have device communication link failure status, Output Status “OUTS” should be set to notify operator and output should keep the last output value.
RSV1	DINT	32 bits reserved Pin Input field for later usage
RSV2	DINT	32 bits reserved Pin Input field for later usage

Table 91 SEL2 Pin Input Parameters

SEL2 Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output This exports the most proper value.
OUTS	DINT	Output Status This shows the current output status. Please refer to the “*Status Output*” Definitions table below for more details

Table 92 SEL2 Pin Output Parameters

Status Output Definitions

Bit Position	Definition	Description
1	SEL_1	Select First Input Value
2	SEL_2	Select Second Input Value
4	AVE	Select the average
5	LINK_F	I/O Communication Link Failure Or Exchange Failure
6	OUT_RANGE	Auto Mode Output Options Out of Range
15	AUTO	Current function block operation mode is Auto
16	MANUAL	Current function block operation mode is Manual

Table 93 Status Output Definitions

2.16 SEL3

If a process value input has to be connected from three different sources, function block “SEL3” might be able to provide a flexible solution. It receives all three input sources and selects the most appropriate value for the output. It has manual and auto operation mode. “SEL3” provides four commands for problem solving in Auto mode, “Select High”, “Select Low”, “Average” and “Select Middle”. When the function block is under Manual mode, the operator has only three output selection options. Those options are “Select the first input value”, “Select the second input value”, and “Select the third input value”.

2.16.1 Parameters

SEL3 Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
MODE	BOOL	Function Block Operation Mode 0: Manual mode [Default] 1: Auto mode
MANU	SINT	Manual Mode Output Options When the operation mode is “Manual”, operator could freely select output value when the corresponding input value has a proper device connection. 0: Select First Input Value [Default] 1: Select Second Input Value 2: Select Third Input Value
AUTO	SINT	Auto Mode Output Options When the operation mode is “Auto”, operator could have more flexible options. 0: Select the Low value [Default] 1: Select the High value 2: Select the Average 3: Select the Middle value
VLU1	REAL	First Input Value This is the first input value. Default: 0.0
ST1	BOOL	First Input Status It shows “VLU1” connected device communication link status. 0: Device Communication Connecting. [Default] 1: Device Communication Failure. Warning: Manual Mode -- When the selected input value has device communication link failure, Output Status “OUTS” should be set to notify operator and output should keep last succeeded output value with respect to the current selection. Ex: If the current selection is selecting the first input value, but the first input status is

		set, then function block should export the last succeeded output value of the first input value. Auto Mode -- When all “ST1”, “ST2” & “ST3” have device communication link failure status, Output Status “OUTS” should be set to notify operator and output should keep the last output value.
VLU2	REAL	Second Input Value This is the second input value Default: 0.0
ST2	BOOL	Second Input Status It shows “VLU2” connected device communication link status. 0: Device Communication Connecting. [Default] 1: Device Communication Failure. Warning: Manual Mode -- When the selected input value has device communication link failure, Output Status “OUTS” should be set to notify operator and output should keep last succeeded output value with respect to the current selection. Ex: If the current selection is selecting the first input value, but the first input status is set, then function block should export the last succeeded output value of the first input value. Auto Mode -- When all “ST1”, “ST2” & “ST3” have device communication link failure status, Output Status “OUTS” should be set to notify operator and output should keep the last output value.
VLU3	REAL	Third Input Value This is the second input value Default: 0.0
ST3 [N/A]	DINT	Status 3 It shows “VLU3” device connecting status. VLU3 is a DINT type parameter and each bit represents different meaning. Note: Please see *Status Input* definition table for each bit corresponding.
ST3	BOOL	Third Input Status It shows “VLU3” connected device communication link status. 0: Device Communication Connecting. [Default] 1: Device Communication Failure. Warning: Manual Mode -- When the selected input value has device communication link failure, Output Status “OUTS” should be set to notify operator and output should keep last succeeded output value with respect to the

		current selection. Ex: If the current selection is selecting the first input value, but the first input status is set, then function block should export the last succeeded output value of the first input value. Auto Mode -- When all “ST1”, “ST2” & ”ST3” have device communication link failure status, Output Status “OUTS” should be set to notify operator and output should keep the last output value.
RSV1	DINT	32 bits reserved Pin Input field for later usage
RSV2	DINT	32 bits reserved Pin Input field for later usage

Table 94 SEL3 Pin Input Parameters

SEL3 Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output This exports the most proper value.
OUTS	DINT	Output Status This shows the current output status. Please see the “*Status Output*” Definitions Table below for more details

Table 95 SEL3 Pin Output Parameters

Status Output Definitions

Bit Position	Definition	Description
1	SEL_1	Select First Input Value
2	SEL_2	Select Second Input Value
3	SEL_3	Select Third Input Value
4	AVE	Select the average
5	LINK_F	I/O Communication Link Failure Or Exchange Failure
6	OUT_RANGE	Auto Mode Output Options Out of Range
15	AUTO	Current function block operation mode is Auto
16	MANUAL	Current function block operation mode is Manual

Table 96 Status Output Definitions

2.16.2 Description

2.16.2.1. Select Manual or Automatic

When the Function Block Operation Mode (MODE) is FALSE (Manual mode), the operator decides the output (AO) value. This function block does not have any operation formula; therefore the selected input value (VLU1, VLU2 or VLU3) can directly be set as the output.

When the Function Block Operation Mode (MODE) is TRUE (Auto mode), the function block depends on the Auto Mode Output Options (AUTO) to determine the proper output value.

2.16.2.2. Set MANU or AUTO Options

Manual Mode Output Options (MANU) allows the operator to select the most appropriate output between First Input Value (VLU1), Second Input Value (VLU2) and Third Input Value (VLU3). Selecting the First Input is MANU default value. If the operator inputs an incorrect value (within the Range 1~2), the output will be maintained as the previous value.

Auto Mode Output Options (AUTO) allows the operator to give the function block a command on the output selection process. These commands are “Select Low”, “Select High”, “Average” and “Select Middle”. The function block will follow the command to select the required output.

2.16.2.3. Set Input Status

Each input value has its corresponding input status to show the condition of the connected device communication. “SEL3” has three input status connections: “ST1”, “ST2” and “ST3”. These input statuses apply to “SEL3” in both Manual and Auto mode.

Manual mode conditions:
When an input status is set, its corresponding input value might not able to be exported even if it is selected. In this case, the function block should export the last successful output value with respect to the current selection.
For example: If the current selection selects the first input value, but the first input status is set, then the function block should export the last successful output value of first input.

Auto mode conditions:
When input status is/are set in Auto mode, the function block has a different scenario than in Manual mode:

1) When all three input status fields (ST1, ST2 and ST3) are set, none of the inputs has the proper device communication link. In this case, the function block will maintain at the last output value and ignore the current AUTO command. If this happens at the first run, then the output value should be “0.0”.
2) When any two of the Input Status are set, the function block should ignore the current selection and export the only input value that has the proper device communication link.
3) When any one of the Input Status is set, the function block should listen to the AUTO command for decision-making between those remaining input values. In this case, if the operator wants to export the “Middle” value from the remaining input values, the function block will treat it as requesting an “Average” value.
4) When none of the input status fields are set, the function block should select the most proper input value for output.

Warning:

If the operator switches the function block’s operation mode from Auto to Manual, but none of the device connections is established successfully during the changes (ST1, ST2 and ST3 are set) then in this case, the function block should export the last successful output value according to the current MANU command. For example: if the current MANU command is “0”, select First Input, the function block should export the last successfully connected First Input value. If the selected input has never been successful, it should export the initial value “0.0”.

When the operator switches the function block operation mode from Manual to Auto, but none of the device connections are successfully established (ST1, ST2 and ST3 are set) then the function block should maintain at the previous output value.

2.17 Accumulate

This “Accumulate” function block performs a non-stopping sum of the input value and exports the rate with respect to the input value unit per hour as a default. The Operator could reset the accumulated value using the reset button (RST).

2.17.1 Parameters

Accumulate Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
VLU	REAL	Input Value Default: 0.0 Note: The input value unit will directly affect the output unit.
PSET	REAL	Preset Value It gives output an initial value. Default: 0.0 Note: Need to be set before function block is enabled. It has no runtime updates.
RNG	REAL	Period Range Accumulate function block output unit is depending on this RNG. RNG default value is set to 3600.0sec (an hour), so the default output unit should be Input Value unit per hour. Default: 3600.0sec (an hour) Note: This value needs to be set before the function block is enabled. It has no runtime updates.
RST	BOOL	Reset 0: Continue accumulation [Default] 1: Clear the accumulation output Note: When RST is set, AO and CARR should be reset to Zero.
HOLD	BOOL	Hold Output value maintains as previous. 0: Continues with the accumulation [Default] 1: Hold the current output value as previous.
RSV1	DINT	32 bits reserved Pin Input field for later usage

Table 97 Accumulate Pin Input Parameters

Accumulate Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output Export the rate with respect to input value unit per hour as default.
CARR	DINT	Carry Bit Since the maximum value of REAL is 3.402823466E38, CARR should increase “1” when AO has reached the max value. Default: 0

Table 98 Accumulate Pin Output Parameters

2.17.2 Function Block initialization

The user can not access the defined module’s internal parameters directly. The user needs to define a new instance with the same defined module’s type and connect both module and instance together.

Note:

The user could skip this initialization when the user decides not to access its internal parameters.

2.18 HILOALM

This “HILOALM” function block mainly provides a limit alarm service with a Limit Calibration. “Limit Calibration” is a extra distance that counting starts from for the Output High Limit (OHL) or Output Low Limit (OLL) with respect to the Limit Calibration Value (GAP). When input value exceeds the OHL or OLL without limit calibration, the output will set. In the case of using the limit calibration, the output will set when input exceeds the new process range.

2.18.1 Parameters

HILOALM Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
VLU	REAL	Input Value Default: 0.0 Note: The input value unit will directly affect the output unit.
OHL	REAL	Output High Limit Set the input maximum limit (not including this value) Default: 0.0
OLL	REAL	Output Low Limit Set the input minimum limit (not including this value) Default: 0.0
GAP	REAL	Limit Calibration Value “Limit Calibration” is a extra distance that counting starts from for the Output High Limit (OHL) or Output Low Limit (OLL) with respect to GAP. When GAP is a positive value, both OHL and OLL should adjust toward each other. When GAP is a negative value, both OHL and OLL should adjust against each other. Default: 0.0 (No Limit Calibration)

Table 99 HILOALM Pin Input Parameters

HILOALM Pin Output Parameters

Name	Data Type	Description
AO	BOOL	Function Block Output True: Input has been exceed the OHL/OLL with or without Limit Calibration False: Input has not exceed the OHL/OLL with or without Limit Calibration

Table 100 HILOALM Pin Output Parameters

2.18.2 Description

2.18.2.1. Set Output Limit (OHL & OLL)

Both OHL and OLL default values are 0.0. When both OHL and OLL are set, the output value will be TRUE if the input value exceeds either the OHL or OLL.

2.18.2.2. Set Limit Calibration (GAP)

The GAP default value is 0.0 (No Limit Calibration). "Limit Calibration" is a extra distance that counting starts from for the Output High Limit (OHL) or Output Low Limit (OLL) with respect to GAP.

1) When GAP is a positive value, both OHL and OLL should adjust toward each other.
2) When GAP is a negative value, both OHL and OLL should adjust against each other.

Example 1:
OHL = 10.0, OLL = -10.0, GAP = 2.0
THEN new process range should be from –8.0 to 8.0 (including both –8.0 and 8.0).

Example 2:
OHL = 10.0, OLL = -10.0, GAP = -2.0
THEN new process range should be from –12.0 to 12.0 (including both –12.0 and 12.0).

2.19 HILOEALM

This “HILOEALM” function block mainly provides a limit alarm service with a limit calibration. “Limit Calibration” is a distance that counting starts from for the Output High Limit (OHL) or Output Low Limit (OLL) with respect to the Limit Calibration Value (GAP). When input value is equal to or exceeds the OHL or OLL without limit calibration, the output should be set. In the case of using limit calibration, the output should be set when input is equal to or exceeds the new process range.

2.19.1 Parameters

HILOEALM Pin Input Parameters

Name	Data Type	Description
VLU	REAL	Input Value Default: 0.0 Note: The input value unit will directly affect the output unit.
OHL	REAL	Output High Limit Set the input maximum limit. Output is set when the input value is equal to or exceeds this OHL without Limit Calibration. Default: 0.0
OLL	REAL	Output Low Limit Set the input minimum limit. Output is set when the input value is equal to or exceeds this OLL without Limit Calibration. Default: 0.0
GAP	REAL	Limit Calibration Value “Limit Calibration” is a distance that counting starts from for the Output High Limit (OHL) or Output Low Limit (OLL) with respect to GAP. When GAP is a positive value, both OHL and OLL should adjust toward each other. When GAP is a negative value, both OHL and OLL should adjust against each other. Default: 0.0 (No Limit Calibration)

Table 101 HILOEALM Pin Input Parameters

HILOEALM Pin Output Parameters

Name	Data Type	Description
AO	BOOL	Function Block Output True: Input is equal to or exceeds the OHL/OLL with or without limit calibration False: Input is not equal to or exceeds the OHL/OLL with or without limit calibration

Table 102 HILOEALM Pin Output Parameters

2.19.2 Description

2.19.2.1. Set Output Limit (OHL & OLL)

Both OHL and OLL default values are 0.0. Output (AO) should be set when the input value has reached or exceeded OHL or OLL value without Limit Calibration.
Warning: If OLL is set as 0.0, output (AO) might set when input value (VLU) starts from 0.0

2.19.2.2. Set Limit Calibration (GAP)

GAP default value is 0.0 (No Limit Calibration). "Limit Calibration" is a distance that counting starts from for the Output High Limit (OHL) or Output Low Limit (OLL) with respect to GAP.

1) When GAP is a positive value, both OHL and OLL should adjust toward each other.
2) When GAP is a negative value, both OHL and OLL should adjust against each other.

Example 1:
OHL = 10.0, OLL = -10.0, GAP = 2.0
THEN new process range should be from –8.0 to 8.0 (Not including both –8.0 and 8.0).

Example 2:
OHL = 10.0, OLL = -10.0, GAP = -2.0
THEN new process range should be from –12.0 to 12.0 (Not including both –12.0 and 12.0).

2.20 SGP

This “SGP” function block exports saturated water capacity from a corresponding input pressure value. “SGP” uses two tables, the Water Capacity Table and the Pressure Table, for searching.

2.20.1 Parameters

SGP Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable SGP [Default] 1: Enable SGP
P	REAL	Pressure Value Function block is using this pressure value for finding the corresponding water capacity value from tables. If the pressure value exceeds the minimum or maximum value in pressure table, it will export the minimum or maximum value from water capacity table. Default: 0.001 [minimum pressure] 22.0 [maximum pressure]
RESV	DINT	32 bits reserved Pin Input field for later usage

Table 103 SGP Pin Input Parameters

SGP Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output It will give out the water capacity with the current pressure. Note: Range 129.208 ~ 0.003757

Table 104 SGP Pin Output Parameters

2.20.2 Description

2.20.2.1. Pressure Table

The Pressure Table has 37 entries.
{0.0010, 0.0020, 0.0030, 0.0040, 0.0050, 0.0060, 0.0080, 0.0100, 0.0120, 0.0150, 0.0200, 0.0250, 0.0300, 0.0500, 0.1000, 0.1200, 0.1400, 0.1600, 0.1800, 0.2000, 0.3000, 0.5000, 0.7000, 1.0000, 1.5000, 2.0000, 2.5000, 3.0000, 3.5000, 4.0000, 5.0000, 7.5000, 10.0000, 12.0000, 15.0000, 20.0000, 22.0000}

2.20.2.2. Water Capacity Table

The Water Capacity Table has 37 entries.
{129.2080000, 67.0060000, 45.6680000, 34.8030000, 28.1960000, 23.7420000, 18.1060000, 14.6760000, 12.3640000, 10.0250000,

7.6515000, 6.2060000, 5.2308000, 3.2415000, 1.6946000, 1.4289000, 1.2370000, 1.0917000, 0.9777500, 0.8859200,
0.6058600, 0.3748100, 0.2727400, 0.1943000, 0.1316500, 0.0995300, 0.0799000, 0.0666200, 0.0570200, 0.4079400,
0.0394100, 0.0253000, 0.0180000, 0.0142500, 0.0103500, 0.0058730, 0.0037570}

2.20.2.3. Pressure Offset Formula [Info. N/A for end user]

If the pressure input value does not exactly match any value in pressure table, it will use the following formula to calculate a more accurate water capacity.

$$AO = \frac{(WCT[index+1] - WCT[index])}{(PT[index+1] - PT[index])} * (VLU - PT[index] + WCT[index]$$

WCT[ ] = Water Capacity Table
PT[ ] = Pressure Table
index = Table Index
VLU = Pressure Input Value (from PIN)

2.21 Characterizer

This “Characterizer” function block uses sets of user-specified data to analyze a non-linear input. A user could provide a maximum of 20 sets of specified data.

2.21.1 Operation Formula

Non-Exact Match Input Formula:

$$AO_n = OUT_{n-1} + RATIO * (IN_n – IN_{n-1})$$

Note:

AO_n = Function block output
IN_n = Input Value
IN_{n-1} = Lower data set input value that approaches IN_n
IN_{n+1} = Upper data set input value that approaches IN_n
OUT_{n-1} = Lower data set output value that approaches IN_n
OUT_{n+1} = Upper data set output value that approaches IN_n
RATIO = $(OUT_{n+1} – OUT_{n-1}) / (IN_{n+1} – IN_{n-1})$

2.21.2 Parameters

Characterizer Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable Characterizer [Default] 1: Enable Characterizer
IN	REAL	Input Value It has no unit restriction on the Input Value, but Input Value unit should match all Data Set input unit in Internal Parameters.
RESV	DINT	32 bits reserved Pin Input field for later usage

Table 105 Characterizer Pin Input Parameters

Characterizer Pin Output Parameters

Name	Data Type	Description
AO	REAL	Function Block Output
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 106 Characterizer Pin Output Parameters

Characterizer Internal Input Parameters

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter receive the proper Instance Address from connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter needs to access this function block. Default: 13
SET	DINT	Set of Data The total number of data set in table should be used in the current analysis. Range 0 ~ 20 “0” means no data set in table. [Default] “20” means 20 data sets in table.
S1A	REAL	Input of 1st Data Set Default: 0.0
S1B	REAL	Output of 1st Data Set Default: 0.0
S2A	REAL	Input of 2nd Data Set Default: 0.0
S2B	REAL	Output of 2nd Data Set Default: 0.0
S3A	REAL	Input of 3rd Data Set Default: 0.0
S3B	REAL	Output of 3rd Data Set Default: 0.0
S4A	REAL	Input of 4th Data Set Default: 0.0
S4B	REAL	Output of 4th Data Set Default: 0.0
S5A	REAL	Input of 5th Data Set Default: 0.0
S5B	REAL	Output of 5th Data Set Default: 0.0
S6A	REAL	Input of 6th Data Set Default: 0.0
S6B	REAL	Output of 6th Data Set Default: 0.0
S7A	REAL	Input of 7th Data Set Default: 0.0
S7B	REAL	Output of 7th Data Set Default: 0.0
S8A	REAL	Input of 8th Data Set Default: 0.0
S8B	REAL	Output of 8th Data Set Default: 0.0
S9A	REAL	Input of 9th Data Set Default: 0.0
S9B	REAL	Output of 9th Data Set Default: 0.0
S10A	REAL	Input of 10th Data Set Default: 0.0

S10B	REAL	Output of 10th Data Set Default: 0.0
S11A	REAL	Input of 11th Data Set Default: 0.0
S11B	REAL	Output of 11th Data Set Default: 0.0
S12A	REAL	Input of 12th Data Set Default: 0.0
S12B	REAL	Output of 12th Data Set Default: 0.0
S13A	REAL	Input of 13th Data Set Default: 0.0
S13B	REAL	Output of 13th Data Set Default: 0.0
S14A	REAL	Input of 14th Data Set Default: 0.0
S14B	REAL	Output of 14th Data Set Default: 0.0
S15A	REAL	Input of 15th Data Set Default: 0.0
S15B	REAL	Output of 15th Data Set Default: 0.0
S16A	REAL	Input of 16th Data Set Default: 0.0
S16B	REAL	Output of 16th Data Set Default: 0.0
S17A	REAL	Input of 17th Data Set Default: 0.0
S17B	REAL	Output of 17th Data Set Default: 0.0
S18A	REAL	Input of 18th Data Set Default: 0.0
S18B	REAL	Output of 18th Data Set Default: 0.0
S19A	REAL	Input of 19th Data Set Default: 0.0
S19B	REAL	Output of 19th Data Set Default: 0.0
S20A	REAL	Input of 20th Data Set Default: 0.0
S20B	REAL	Output of 20th Data Set Default: 0.0

Table 107 Characterizer Internal Input Parameters

2.21.3 Description

2.21.3.1. Set Data Table

There are two tables in the source code. Each table has 20 entries. One of the tables contains input values that should be compared with the Input Value (IN). Another table contains output values that should show an output according to the Input Value (IN). These entries can imported to the internal input parameters by the operator. These tables could be updated during runtime.

2.22 BCA

This “BCA” function block mainly provides a binary control algorithm to control majority binary equipment, such as: pumps, electrical engines, valves, electronic devices etc.

Equipment types:

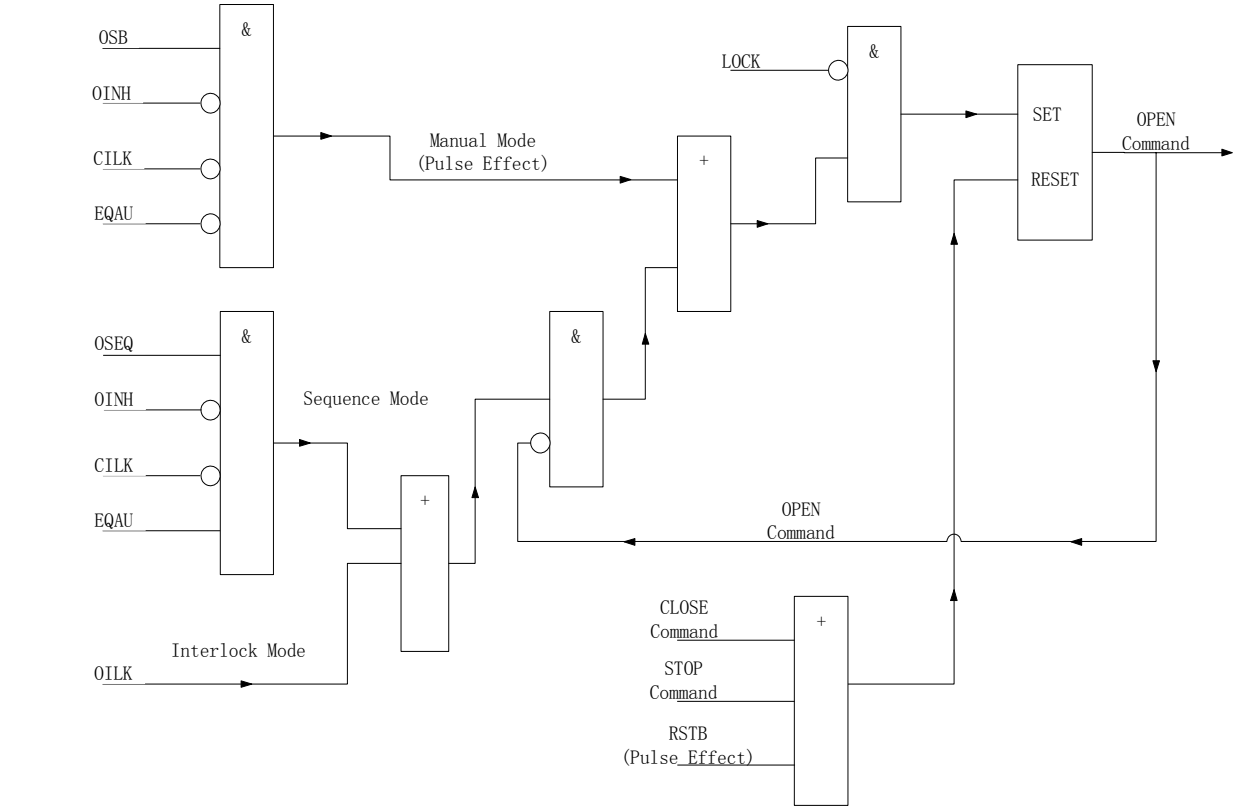
1) For equipment, the output usually has the following options: “Effective on the condition of Switch On, Off and Pause”, “Effective on the condition of Switch On and Off” and “Effective on the condition of On only.”
2) For equipment, the feedback usually includes: “Feedback on the condition of Switch On and Off”, “Feedback on the condition of Switch On only” and “No Feedback”.

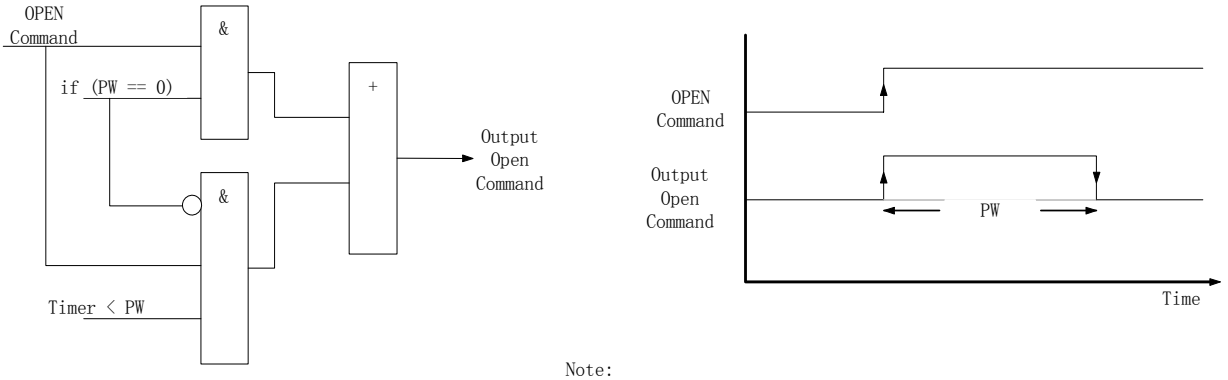
Equipment control:

For equipment, operation mode usually has the following types:

1) Manual mode,
2) Sequence mode,
3) Interlock mode.

2.22.1 Open/Start Command Operation Graph

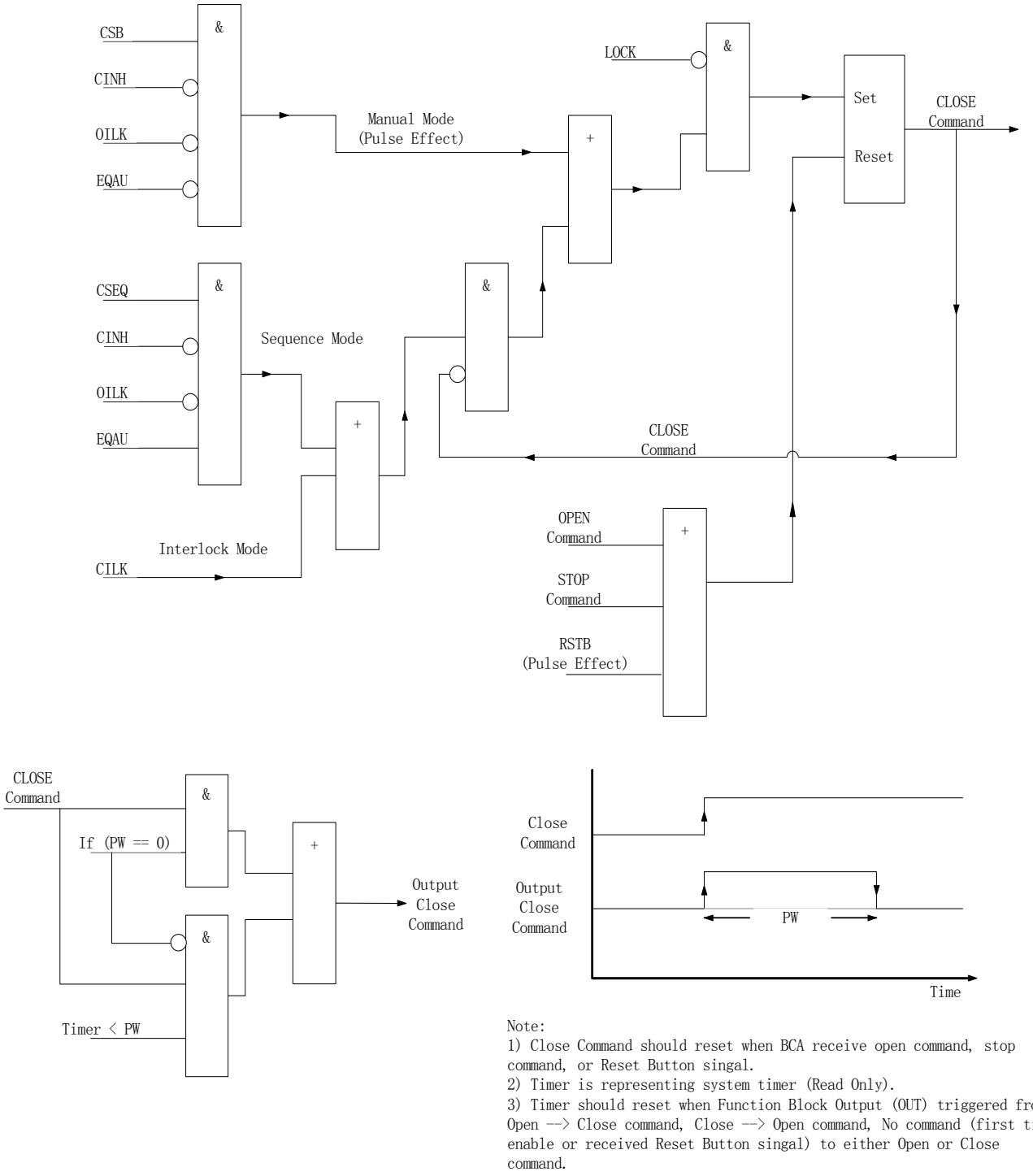




Note:
1) Open Command should reset when BCA receive Close command, stop command, or Reset Button singal.
2) Timer is representing system timer (Read Only).
3) Timer should reset when Function Block Output (OUT) triggered from Open --> Close command, Close --> Open command, No command (first time enable or received Reset Button singal) to either Open or Close command.

Figure 18 Open/Start Command Operation Graph

2.22.2 Close/Trap Command Operation Graph



Note:
1) Close Command should reset when BCA receive open command, stop command, or Reset Button singal.
2) Timer is representing system timer (Read Only).
3) Timer should reset when Function Block Output (OUT) triggered from Open --> Close command, Close --> Open command, No command (first time enable or received Reset Button singal) to either Open or Close command.

Figure 19 Close/Trap Command Operation Graph

2.22.3 Stop Operation Graph

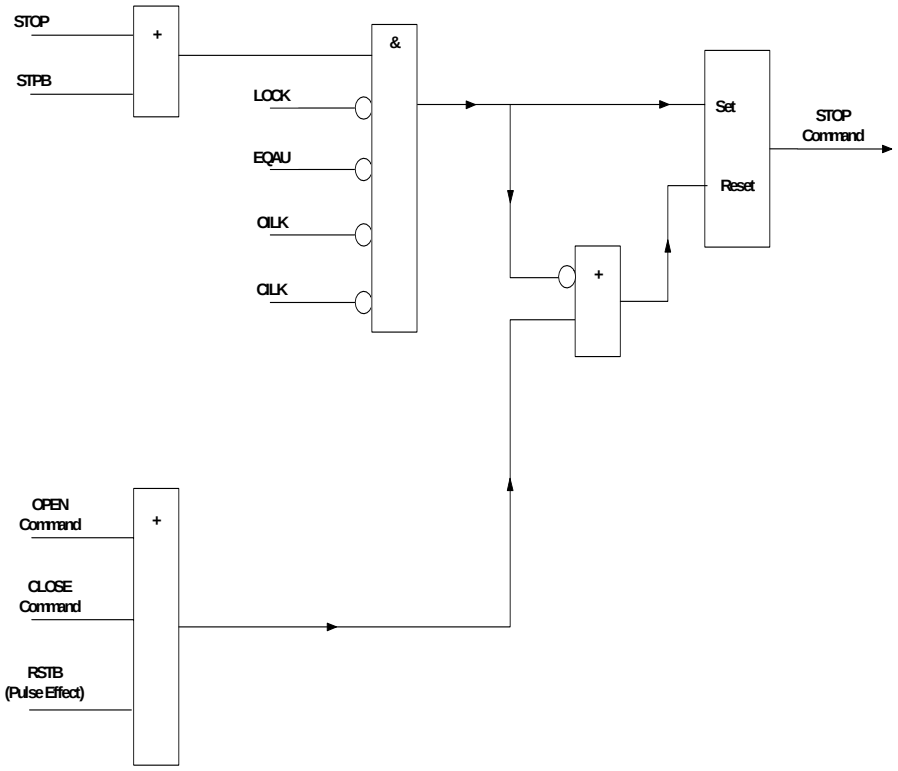


Figure 20 Stop Operation Graph

2.22.4 Parameters

BCA Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable / Default 1: Enable
OILK	BOOL	Open/Start Interlock Command 0: Not set Open Interlock Command [Default] 1: Set Open Interlock Command
CILK	BOOL	Close/Trap Interlock Command 0: Not set Close Interlock Command [Default] 1: Set Close Interlock Command
OSEQ	BOOL	Open/Start Sequence Command 0: Not set Open Sequence Command [Default] 1: Set Open Sequence Command Note: Sequence command cannot work with Interlock command
CSEQ	BOOL	Close/Trap Sequence Command 0: Not set Close Sequence Command [Default] 1: Set Close Sequence Command Note: Sequence command cannot work with Interlock command
OINH	BOOL	Open/Start Command Inhibited

		0: No open permit [Default] 1: Gain open permit Note: Restricted to open equipment by using Open/Start Push Button and Open/Start Sequence Command.
CINH	BOOL	Close/Trap Command Inhibited 0: No close permit 1: Gain close permit Note: Restricted to close equipment by using Close/Trap Push Button and Close/Trap Sequence Command.
OFB	BOOL	Open/Start Feedback Command Get current equipment status for Open/Start. 0: Equipment is not opened [Default] 1: Equipment is opened successfully
CFB	BOOL	Close/Trap Feedback Command Get current equipment status for Close/Trap. 0: Equipment is not closed [Default] 1: Equipment is closed successfully
STOP	BOOL	Equipment Stop Command 0: Not set Stop Command [Default] 1: Set Stop Command
RESV	DINT	32 bits reserved Pin Input field for later usage

Table 108 BCA Pin Input Parameters

BCA Pin Output Parameters

Name	Data Type	Description
OUT	DINT	Function Block Output This is an Equipment controlling output for giving one of the following commands each time: On, Off, or Stop. e.g. 1st bit > 0 = On 2nd bit > 0 = Off 9th bit > 0 = Stop
MSG	SINT	Equipment Message Display the current equipment condition. Please refer to the “MSG” Definitions table below for more details
ALM	SINT	Equipment Alarm Display the current equipment Error. Please refer to the “ALM” Definitions table below for more details
AMW	DINT	Auto Mode Warning It is a 32-bit Standard Alarm and mainly shows the function block status in Auto mode. Please check the AMW Definitions table below for details.
IA	DINT	Instance Address IA output the current function block internal parameters address. e.g. ParamReader or ParamWriter could gain access to function block’s internal parameters by receiving this IA.

Table 109 BCA Pin Output Parameters

MSG Definitions

Value	Definition	Description
0	STOP	Stop the equipment
1	OPEN	Open the equipment
2	OPENING	Equipment is opening
3	OPENED	Equipment is opened
4	CLOSE	Close the equipment
5	CLOSING	Equipment is closing
6	CLOSED	Equipment is closed
7	FAIL	Equipment Failure

Table 110 MSG Definitions

ALM Definitions

Value	Definition	Description
0	NOALM	No Alarm
1	NOFB	Do not receive any feedback from equipment
2	FBALLON	Received both open and close feedback from equipment
3	ILKALLON	Both open and close Interlock Commands are set
4	NOILKNOPMT	Both open and close inhibit commands are set without receiving any interlock command.
5	TWOPB	Two or more push buttons are set “Open/Start and Close/Trap Push Button”, “Open/Start and Stop Push Button”, or “Close/Trap and Stop Push Button”
6	NOOPEN	Failed to open the equipment No open feedback return from equipment
7	NOCLOSE	Failed to close the equipment No close feedback return from equipment
8	EQLTRAP	Equipment is Trapped Equipment is opened and lost open feedback after Travel Time (OTRV).
10	LOCSTART	Equipment is closed and lost close feedback after Travel Time (OTRV).
11	SEQALLON	Both Open/Start and Close/Trap Sequence modes are set with Equipment Auto.

Table 111 ALM Definitions

AMW Definitions

Bit Position	Definition	Description
1	EAUTO	Equipment is in Auto mode
6	LOCK	Equipment is locked
7	ALARM	Equipment Alarm – need to check the “ALM” for more details
8	STOP	“Equipment Stop” input value
9	OILK	“Open/Start Interlock Command” input value
10	CILK	“Close/Trap Interlock Command” input value
11	OINH	“Open/Start Command Inhibit” input value
12	CINH	“Close/Trap Command Inhibit” input value
13	OSEQ	“Open/Start Sequence Command” input value

14	CSEQ	“Close/Trap Sequence Command” input value
15	OFB	“Open/Start Feedback Command” input value
16	CFB	“Close/Trap Feedback Command” input value

Table 112 AMW Definitions

BCA Internal Parameters

Name	Data Type	Description
FLAG [REFERENCE ONLY]	DINT	Address Identification Ensure ParamReader and ParamWriter to receive the proper Instance Address from the connected function block. Default: 90
FUNT [REFERENCE ONLY]	DINT	Function Block Type FUNT should be used when either ParamReader or ParamWriter needs to access this function block. Default: 12
EQAU	BOOL	Equipment Auto 0: Equipment is not in Auto mode [Default] 1: Equipment is in Auto mode
OSB	BOOL	Open/Start Push Button This parameter has pulse effect. Once the function block takes effect of open button, function block should not take effect for OSB command unless OSB is set from 0 again. 0: Open/Start push button is “OFF” [Default] 1: Open/Start push button is “ON”
CTB	BOOL	Close/Trap Push Button This parameter has pulse effect. Once the function block took effect of close button, function block should not take effect for CTB command unless CTB is set from 0 again. 0: Close/Trap push button is “OFF” [Default] 1: Close/Trap push button is “ON”
STPB	BOOL	Stop Push Button 0: Stop push button is “OFF” [Default] 1: Stop push button is “ON”
RSTB	BOOL	Reset Push Button This parameter has pulse effect. Once the function block took effect of Reset button, function block should not take effect till RSTB is set from ZERO again. 0: Reset push button is “OFF” [Default] 1: Reset push button is “ON” Note: Operator would not see the reset affection when BCA is giving out stop command. It is too fast for operator to catch the changes because BCA would maintain to giving out stop command as long as either STOP or STPB reminds at “TRUE” status.
LOCK	BOOL	Equipment Lock Equipment would not receive any Open, Close or Stop command when equipment is

		locked. 0: Equipment is not locked [Default] 1: Equipment is locked
PW	DINT	Equipment Pulse Width Once the function block gives out the proper output command (after received the corresponding feedback), output command should maintain till Pulse Width time is expired. Range is 0 ~ 1000 sec
TRV	DINT	Travel Time It is a period of time for function block to wait for open or close feedback from controlling device. While function block is waiting for feedback, MSG should show either on Opening or Closing command. Range is 0 ~ 3600 sec

Table 113 BCA Internal Parameters

2.22.5 Description

2.22.5.1. Manual Mode

Manual mode means the function block does not receive an Equipment Auto (EQAU) command from the operator. Please consider the following conditions for Open/Start, Close/Trap, and Stop:

1) Open/Start:
   No LOCK
   No EQAU
   No OINH
   No OILK
   Have OSB
2) Close/Trap:
   No LOCK
   No EQAU
   No CINH
   No CILK
   Have CTB
3) Stop:
   No LOCK
   No EQAU
   No OILK
   No CILK
   Have STPB

2.22.5.2. Sequence Mode

Sequence Mode means the function block could receive an Equipment Auto (EQAU) command from the operator. Please consider the following conditions for Open/Start and Close/Trap:

1) Open/Start:
   No LOCK
   No OILK
   No OINH
   Have EQAU
   Have OSEQ
2) Close/Trap:

No LOCK
No CILK
No CINH
Have EQAU
Have CSEQ

2.22.5.3. Interlock Mode

Interlock Mode means the function block could provide an output command with no restriction on Equipment Auto (EQAU). Please consider the following conditions for Open/Start and Close/Trap:

1) Open/Start:
   No LOCK
   Have OILK
2) Close/Trap:
   No LOCK
   Have CILK

2.22.5.4. Logical Input for Stop Command

The BCA takes two kinds of “Stop” command. The user could either input the Stop command manually using Stop Push Button (STPB) or the logical input from the Equipment Stop Command (STOP). Please consider the following conditions for the “Stop” command:

1) The Manual Mode Stop Command needs:
   No LOCK
   No EQAU
   No OILK
   No CILK
   Have STPB
2) The Logical Input Stop Command needs:
   No LOCK
   No EQAU
   No OILK
   No CILK
   Have STOP

2.22.5.5. Equipment Lock Function (LOCK)

Equipment Lock (LOCK) is an internal parameter. When it is set, the function block does not give out any output command (e.g. Open, Close, or Stop) to the equipment.

2.22.5.6. Reset Function

Reset Push Button (RSTB) is an internal parameter with pulse effect. RSTB could cause BCA to clear its current status and re-check the conditions for a new output command. Be aware of the following cases:

1) Since some push buttons have pulse effect, DO NOT use RSTB when the function block is waiting for Feedback from equipment because the function block would clear the current status and wait for the new inputs.
2) When function block has received Feedback from equipment with Pulse Width time, RSTB would set the counting time starting from ZERO.

2.23 VCPT

This “VCPT” function block gives out the volume of steam-gas from a corresponding pressure and temperature.

2.23.1 Parameters

VCPT Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Enable VCPT [Default] 1: Disable VCPT
P	REAL	Pressure Value The function block uses the pressure and a temperature value for finding the corresponding volume of steam-gas from the tables. If the pressure value exceeds the minimum or maximum value in pressure table, it will assume the input pressure value as a minimum or a maximum value from the table. Default: 0.1 [minimum pressure] 17.0 [maximum pressure]
T	REAL	Temperature Value The function block uses the temperature and a pressure value for finding the corresponding density of steam-gas from tables. If the temperature value exceeds the minimum or maximum value in the temperature table, it will assume the input temperature value as a minimum or a maximum value from the table. Default: 0.0 [minimum temperature] 600.0 [maximum temperature]
RESV	DINT	32 bits reserved Pin Input field for later usage

Table 114 VCPT Pin Input Parameters

VCPT Pin Input Parameters

Name	Data Type	Description
AO	REAL	Function Block Output It will give out the density of steam-gas with the given pressure and temperature value.

Table 115 VCPT Pin Output Parameters

2.23.2 Description

2.23.2.1. Steam-Gas Table

This Steam-Gas Table has 12 x 15 entries:

{0.0010002, 0.0010017, 0.0010078, 0.0010171, 1.8890000,
1.9840000, 2.0780000, 2.1720000, 2.6390000, 2.8710000,
3.1030000, 3.3340000, 3.5650000, 3.7970000, 4.0280000},
{0.0010000, 0.0010015, 0.0010076, 0.0010169, 0.0010800,
0.3836000, 0.4046000, 0.4249000, 0.5226000, 0.5701000,
0.6172000, 0.6641000, 0.7109000, 0.7575000, 0.8040000},
{0.0009997, 0.0010013, 0.0010074, 0.0010167, 0.0010796,
0.0011019, 0.1944000, 0.2059000, 0.2580000, 0.2825000,
0.3066000, 0.3304000, 0.3540000, 0.3776000, 0.4010000},
{0.0009992, 0.0010008, 0.0010069, 0.0010162, 0.0010790,
0.0011012, 0.0011266, 0.0011560, 0.1255000, 0.1386000,
0.1512000, 0.1635000, 0.1756000, 0.1876000, 0.1995000},
{0.0009987, 0.0010004, 0.0010065, 0.0010158, 0.0010783,
0.0011005, 0.0011258, 0.0011550, 0.0811600, 0.0905300,
0.0993300, 0.1078000, 0.1161000, 0.1243000, 0.1324000},
{0.0009982, 0.0009999, 0.0010060, 0.0010153, 0.0010777,
0.0010997, 0.0011249, 0.0011540, 0.0588500, 0.0664500,
0.0733900, 0.0799900, 0.0863800, 0.0926400, 0.0987900},
{0.0009977, 0.0009995, 0.0010056, 0.0010149, 0.0010771,
0.0010990, 0.0011241, 0.0011530, 0.0453200, 0.0519400,
0.0578000, 0.0632700, 0.0685300, 0.0736300, 0.0786400},
{0.0009972, 0.0009990, 0.0010051, 0.0010144, 0.0010764,
0.0010983, 0.0011232, 0.0011519, 0.0361600, 0.0422300,
0.0473800, 0.0521200, 0.0566200, 0.0609600, 0.0653100},
{0.0009958, 0.0009977, 0.0010038, 0.0010131, 0.0010745,
0.0010961, 0.0011207, 0.0011490, 0.0014022, 0.0257900,
0.0299300, 0.0334800, 0.0367500, 0.0398400, 0.0428100},
{0.0009943, 0.0009964, 0.0010026, 0.0010118, 0.0010727,
0.0010940, 0.0011183, 0.0011461, 0.0013895, 0.0172100,
0.0210800, 0.0241100, 0.0267900, 0.0292600, 0.0316100},
{0.0009928, 0.0009950, 0.0010013, 0.0010105, 0.0010709,
0.0019109, 0.0011159, 0.0011432, 0.0013779, 0.0114800,
0.0156600, 0.0184500, 0.0207900, 0.0229100, 0.0248900},
{0.0009919, 0.0009942, 0.0010004, 0.0010096, 0.0010697, 0
.0010906, 0.0011143, 0.0011414, 0.0013707, 0.0017286, 0.0130300,
0.0157600, 0.0179700, 0.0199200, 0.0217300},

2.23.2.2. Formula of Finding the Critical Temperature Point

$$Tvalue = (TCritical[Pindex+1] - TCritical[Pindex]) x \frac{P - PArray[Pindex]}{PArray[PIndex+1] - PArray[PIndex])} + TCritical[Pindex]$$

Note:

Tvalue = Critical Temperature Point
TCritical[ ] = Sub-Temperature Table as following:
100,52,180,213,234,251,264,276,304,325,343,355
PArray[ ] = Sub-Pressure Table as following:
0.1, 0.5, 1, 2, 3, 4, 5, 6, 9, 12, 15, 17
PIndex = A matched or the nearest value at Sub-Pressure Table with “P”
P = Pressure value from Input

2.24 Inertia

This “Inertia” function block provides a time control tracking system between the Input (Process Value, PV) and the Tracking Output (AO). The Inertia function allows operator to adjust the AO starting point by giving it an Offset (OSET) value. The operator can input a different value for the Time Constant (CTIM) to control the AO speed rate increase or decrease. Inertia also allows the operator to disable its function and export the PV directly by using Go Direct (DIR) function.

2.24.1 Formula

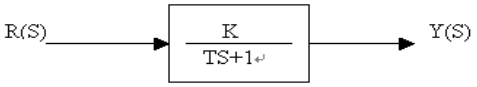


Figure 21 Inertia Transformation Formula

Fourier Formula of Figure 1.1:

$$AO = \Delta PV\ (1 - e^{-t / TIME}) + AO_0 + OSET$$

Note: AO = Tracking Output
ΔPV = Distance between new PV and pervious PV
t = Real Time
TIME = Time Constant (Set by operator)
AO_0 = New ΔPV Starting Output
OSET = Offset

2.24.2 Parameters

Inertia Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
CTIM	REAL	Constant Time Give a constant time to control the output speed rate. The Default unit is second. Default: 0.001 (One Millisecond) e.g. 1 second = 1.0 1 minute = 60.0 1 hour = 3600.0 Note: 1) When CTIM was updated at runtime, output calculation will use the most updated CTIM 2) Unit is always setting as Second, no time convert to minute or hour for calculation
PV	REAL	Process Value

		Input a value that output will trace with. Default: 0.0 Note: When PV was updated at runtime, output will trace with the most updated PV
OSET	REAL	Offset Adjust the Tracking Output (AO) starting point by giving it an offset. Default: 0.0
DIR	BOOL	Go Direct 0: Output traces with Process Value (PV) [Default] 1: Set the Tracking Output (AO) as PV directly. Note: Offset (OSET) is still active on Go Direct Mode

Table 116 Inertia Pin Input Parameters

Inertia Pin Output Parameters

Name	Data Type	Description
AO	REAL	Tracking Output Exports the most updated tracking value.

Table 117 Inertia Pin Output Parameters

2.25 Rate

This “Rate” function block provides the real time input change rate calculation service. The output unit depends on the input (Process Value, PV) units with respect to time. The time unit is in seconds, but the operator could input 60.0 to represent a minute and 3600.0 to represent an hour. Therefore the output could be variant unit. For example, Temperature Change Rate “ °C per minute “, Power Change Rate “ MEGAWATT per Second” etc.

2.25.1 Formula

$$AO = \frac{\Delta PV}{Time}$$

Note: AO = PV Change Rate Output
ΔPV = PV value at the end of a period – PV value at beginning of the same period
Time = Rate Period

2.25.2 Parameters

Rate Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
SAMP	REAL	Sample Period This sets a period of time for PV rate change calculation. The starting time will be set either when the function block is enabled or at the end of each period for the next continuous cycle. The smallest unit is millisecond. Default: 0.001 (One Millisecond) e.g. 1 second = 1.0 1 minute = 60.0 1 hour = 3600.0 Note: Function block won’t take any time smaller than one Millisecond.
PV	REAL	Process Value Default: 0.0

Table 118 Rate Pin Input Parameters

Rate Pin Output Parameters

Name	Data Type	Description
AO	REAL	PV Change Rate Output Exports the PV Change Rate that respects to the PV input and Sample Period. Warning: Updates only act at the end of each requested period. e.g. If "TIME" was set to one minute, "AO" won't be modified during the period of 0 ~ 59 sec.
ACT	REAL	Actual Sample Period Exports the current AO sample period.

Table 119 Rate Pin Output Parameters

2.25.3 Hints, Tips and Frequently Asked Questions

Q: How do you set the starting time for the Rate Period?
A: When the function block was set to enable, the first Sample Period starting time is set. The function block will continue to update the PV change of rate after the first period. The end time of each period is set as the next continuous period starting time.

Q: What are the consequences of changing "SAMP" before the end of a period?
A: The function block will update the output immediately with its actual calculation Sample Period "SAMP". Then the function block continues with the new "SAMP".

2.26 RateLimit

This “RateLimit” function block provides a Process Value (PV) speed rate limit checking service to ensure the PV speed rate is within the limits. If the current PV speed rate exceeds Maximum Increase Speed Rate (INCR) or Maximum Decrease Speed Rate (DECR), then the PV Output (PVO) would not follow the change from PV. PVO should change according to INCR when PV is increasing or change according to DECR when PV is decreasing. However, the function block still exports the actual PV change rate on Current Speed Rate (CURR).

When the PV speed rate is within the limit, RateLimit would not take any action to affect the input. This could ensure PV speed rate is under operator control unless the operator manually chooses to not take control on the input by using the “Direct” function. “Direct” allows the real time PV input to go through this function block directly without any speed rate checking procedure even if the PV input exceeds the limits.

2.26.1 Formula

Current Speed Rate:

$$\frac{\Delta PV}{CYCT} = \text{Current Speed Rate}$$

Increase Speed Rate Limit:

$$\frac{PVHL}{SAMP * 1000.0} = \text{Max Increase Speed Rate (per millisecond)}$$

Decrease Speed Rate Limit:

$$\frac{PVLL}{SAMP * 1000.0} = \text{Max Decrease Speed Rate (per millisecond)}$$

Note: ΔPV = Current PV output – Last PV output
CYCT = One Operation Cycle Time
PVHL = PV HI Limit
PVLL = PV LO Limit

2.26.2 Parameters

RateLimit Pin Input Parameters

Name	Data Type	Description
EN	BOOL	Function Block Enable 0: Disable [Default] 1: Enable
SAMP	REAL	Sample Period This time unit is seconds. It is used for calculating both Maximum Increase Speed Rate and Maximum Decrease Speed Rate. The smallest input is One millisecond. Default: 60.0 (1 minute) e.g. 1 second = 1.0 1 minute = 60.0

		1 hour = 3600.0 Note: *+ Any invalid input will set the default value.*
PV	REAL	Process Value Default: 0.0
PVHL	REAL	PV HI Limit Ensure Current Speed Rate (CURR) does not exceed Maximum Increase Speed Rate (INCR). INCR = $\frac{PVLL}{SAMP * 1000.0}$ Default: 0.0 Note: *+ PVLL should have the same unit as Process Value (PV)* *+ Any input bigger than ZERO is considered as an invalid input and an invalid input will be set as the default value*
PVLL	REAL	PV LO Limit Ensure Current Speed Rate (CURR) does not exceed Maximum Decrease Speed Rate (INCR). DECR = $\frac{PVHL}{SAMP * 1000.0}$ Default: 0.0 Note: *+ PVHL should have the same unit as Process Value (PV)* *+ Any input smaller than ZERO is considered as an invalid input and an invalid input will be set as the default value*
DIR	BOOL	Go Direct It allows the user an option of disabling the speed rate restriction and following the Current Speed Rate (CURR). 0: Enable the speed rate comparison. [Default] 1: Lets the Process Value (PV) through function block directly without any speed rate comparison.

Table 120 RateLimit Pin Input Parameters

RateLimit Pin Output Parameters

Name	Data Type	Description
PVO	REAL	Process Value Output Exports the proper PV according to RateLimit input setting.
CURR	REAL	Current Speed Rate Exports the actual PV speed rate even

		if it exceeds the rate limit. This rate unit is “PV unit” per millisecond. CURR = $\frac{\Delta PV}{CYCT}$
INCR	REAL	Maximum Increase Speed Rate Exports the maximum increase speed rate. This rate unit is “PV unit” per millisecond. INCR = $\frac{PVHL}{SAMP * 1000.0}$
DECR	REAL	Maximum Decrease Speed Rate Exports the maximum decrease speed rate. This rate unit is “PV unit” per millisecond. DECR = $\frac{PVLL}{SAMP * 1000.0}$
EQUA	BOOL	Equality Check the speed rate equality between the required rate and current rate. 0: INCR or DECR has been used. 1: CURR has been used.
CYCT	REAL	One Operation Cycle Time CYCT records one operation Cycle Time. CYCT used when RateLimit calculated CURR. This time unit is millisecond.

Table 121 RateLimit Pin Output Parameters

2.26.3 Description

2.26.3.1. Go Direct Mode (DIR)

Go Direct Mode gives user authority to release the speed rate restriction. Function block would export Process Value (PV) to Process Value Output (PVO) directly as using Current Speed Rate (CURR). Otherwise Maximum Increase Speed Rate (INCR) or Maximum Decrease Speed Rate (DECR) might restrict on CURR.

2.26.3.2. Sample Period (SAMP) Updated

“RateLimit” allows the user to modify Sample Period (SAMP) at run time. When SAMP is updated, it will directly change the Maximum Increase Speed Rate (INCR) and the Maximum Decrease Speed Rate (DECR). The unit of SAMP is second. The smallest input is one millisecond. Any invalid input will set the default value of one minute.

2.26.3.3. Equality (EQUA) Output

EQUA should notify the user when the Current Speed Rate (CURR) is applied to the PV Output (PVO). The following conditions should set EQUA to TRUE:

- Go Direct Mode (DIR) was set.
- The Current Speed Rate (CURR) doesn’t exceed the limit.

2.27 MoxPID

The MoxPID function block is a PID controller. This is a type of feedback controller whose output, a control variable (CV), is generally based on the error between a user-defined set point (SP) and a measured process variable (PV). You can use it to tune your control system.

2.27.1 Parameters

Calling Parameters

Name	Data Type	Description
EnFB	BOOL	Enable this function TRUE: Enable Otherwise: Disable
Auto	BOOL	Auto or manual adjusting TRUE: Auto Otherwise: Manual
E_I	BOOL	Use external setpoint or internal setpoint TRUE: External Otherwise: Internal
PV	REAL	Process value
Sp_E	REAL	External setpoint
Sp_I	REAL	Internal setpoint
D_R	BOOL	Direct action or reversed action TRUE: Direct action Otherwise: Reversed
Pg	REAL	Proportion gain
Ig	REAL	Integral gain
Dg	REAL	Derivative gain
YNF	BOOL	Enable trace TRUE: CV traces YN
YN	REAL	Trace value
MSp	REAL	Manual adjusting setpoint offset value
MaxO	REAL	Maximum output (CV) value
MinO	REAL	Minimum output (CV) value
MaxC	REAL	Maximum change value of output (CV) per second
Dead	REAL	Dead band of error changing
Bias	REAL	Control output offset value
Re1	DINT	Reserved
Re2	REAL	Reserved

Table 122 Calling Parameters of MoxPID

Return Parameters

Name	Data Type	Description
RUN	BOOL	Running flag of this function If running, it is TRUE Otherwise, FALSE
CV	REAL	Control output value
HDAC	BOOL	Auto mode flag If auto, this field is TRUE Otherwise, False

Table 123 Return Parameters of MoxPID

2.28 MoxPIDII

The MoxPIDII function block is also a PID controller. This is a type of feedback controller whose output, a control variable (CV), is generally based on the error between some user-defined set point (SP) and some measured process variable (PV). You can use it to tune your control system. It has the following properties:

- Calculate the Proportional-Integral-Derivative according to the process value (PV) and set point (SP).
- Select the different algorithm of the PID.
- Set external or internal set point (SP).
- Select manual or automatic mode.
- Set track input mode.
- Direct or reverse acting.
- Set maximum and minimum output (CV).
- Set maximum and minimum set point (SP).
- Set dead band on deviation.
- Set the maximum output change rate.
- Feed forward component for disturbance compensation.

2.28.1 Formula

A typical PID controller algorithm is as follows:

dP[k] = Kp*dE[k]
dI[k] = (T/Ki)*E[k]
dD[k] = (Kd/T)*d(dE[k])
dCV[k] = dP[k] + dI[k] + dD[k]
CV[K] = CV[k-1] + dCV[k]

where e[k] = SP[k] – PV[k], and T is the sampling interval.
'd' means delta character.

An **I-PD** controller algorithm is as follows:

dP[k] = Kp*dPV[k]
dI[k] = (T/Ki)*E[k]
dD[k] = (Kd/T)*d(dPV[k])
dCV[k] = dP[k] + dI[k] + dD[k]
CV[K] = CV[k-1] + dCV[k]

where e[k] = SP[k] – PV[k], and T is the sampling interval.
'd' means delta character.

A **PI-D** controller algorithm is as follows:

dP[k] = Kp*dE[k]
dI[k] = (T/Ki)*E[k]
dD[k] = (Kd/T)*d(dPV[k])
dCV[k] = dP[k] + dI[k] + dD[k]
CV[K] = CV[k-1] + dCV[k]

where e[k] = SP[k] – PV[k], and T is the sampling interval.
'd' means delta character.

2.28.2 Block Diagram of Typical PID

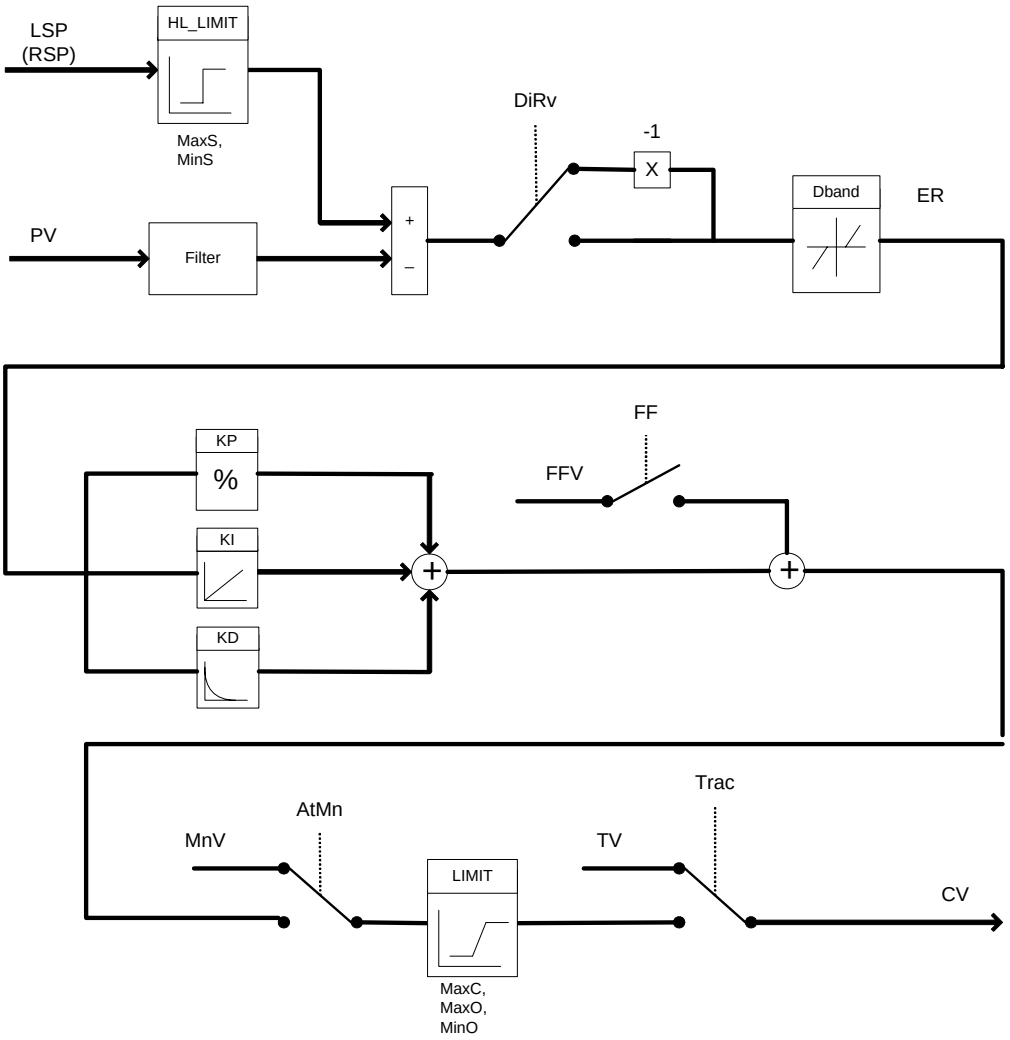


Figure 22 Block Diagram of Typical PID

2.28.3 Parameters

Calling Parameters

Name	Data Type	Description
Enable(EN)	BOOL	Enable this function block 0: Enable; 1: Disable.
SetAlgorithm(Algo)	SINT	the algorithm of PID
AutoManu(AtMn)	BOOL	Manual or automatic mode 0: Manual mode; 1: Automatic mode.
SeriesAM(SAM)	BOOL	The inner loop automatic or manual mode. 0: Inner loop manual mode; 1: Inner loop automatic mode; If RmtLoc is 1, it must use the same variable as AtMn in the inner loop.
RmtLoc(RL)	SINT	Remote or local set point 0: Local mode, no series; 1: Local mode, outer loop; 2: Remote mode, inner loop.
DirRever(DiRv)	BOOL	Direct or reverse mode 0: Reverse; 1: Direct.
TrackEnable(Trac)	BOOL	Track input enable 0: Disable track input mode; 1: Enable track input mode. When track input mode is enabled, the Output (CV) equals to the TraceValue.
FeedforwardEn(FF)	BOOL	Enable feed forward 0: Disable feed forward; 1: Enable feed forward.
RmtSetpoint(RSP)	REAL	Remote set point
LocSetpoint(LSP)	REAL	Local set point
ProcessValue(PV)	REAL	Process value
SeriesPV(SPV)	REAL	The inner loop process value. If RmtLoc is 1, it must use the same variable as PV in the inner loop.
PGain(KP)	REAL	The proportional gain
Igain(KI)	REAL	The integral gain
DGain(KD)	REAL	The derivative gain
TraceValue(TV)	REAL	The trace value
ManuValue(MnV)	REAL	The manual set point
MaxChange(MaxC)	REAL	The maximum output change rate
MaxOutput(MaxO)	REAL	The maximum output
MinOutput(MinO)	REAL	The minimum output
MaxSetpoint(MaxS)	REAL	The maximum set point
MinSetpoint(MinS)	REAL	The minimum set point
DeadBand(Dband)	REAL	Dead band on deviation
FFValue(FFV)	REAL	The feed forward compensation input

Table 124 MoxPIDII Calling Parameters

Return Parameters

Name	Data Type	Description
Run(Run)	BOOL	The run flag of function block 0: The function block is not running; 1: The function block is running.
Output(CV)	REAL	The control variable
SetpointOut(SPO)	REAL	Set point output value. It must use the same variable as LSP if the RmtLoc is 0 or 1. If the RmtLoc is 2, leave it to blank.
MVOut(MnVO)	REAL	Manual value output. It must use the same variable as MnV.

Table 125 MoxPIDII Return Parameters

2.28.4 Description

2.28.4.1. Select the Aalgorithm of PID

When Algo is 1, the typical algorithm is selected. The default value is 1.
When Algo is 2, the I-PD algorithm is selected.
When Algo is 3, the PI-D algorithm is selected.
When Algo is 101, 102, 103..., the output is equal to the manual value directly.

2.28.4.2. Select Manual or Automatic Mode

When AtMn is FALSE, the controller is set in manual mode and the output (CV) is the same as the manual set point (MnV) value.
When AtMn is TRUE, the controller is set in automatic mode and the output (CV) is the value that is tuned by PID algorithm.

2.28.4.3. Track Output Mode

When the PID is in automatic or manual mode, the output (CV) must be tracked in order to avoid output variations moving rapidly when AtMn is switched between automatic and manual mode.
In single loop control, if the AtMn is manual mode, the local set point (LSP) tracks the process value (PV). If the AtMn is automatic mode, the manual set point (MnV) tracks the output (CV).
In multi loops control, when the outer loop is in manual mode and the inner loop is also in manual mode, the manual set point (MnV) of outer loop tracks the process value (PV) of inner loop.

2.28.4.4. Track Input Mode

When Trac is TRUE, the controller is set to be in trace input mode,i.e. the output (CV) is the same as the trace value (TV).
The Track input enable has the highest priority, and the output (CV) only responsed to TV, manual or automatic modes have no function.

2.28.4.5. Set Direct or Reverse

When DiRv is TRUE, the direct action is set. E[k] = PV[k] – SP[k] in algorithm.
When DiRv is FALSE, the reverse action is set. E[k] = SP[k] – PV[k] in algorithm.

2.28.4.6. Set Maximum and Minimum Output

If the output (CV) exceeds the maximum output value, the CV is set to the maximum output value; if the CV is less than the minimum output, then CV is set to the minimum output.

2.28.4.7. Set Maximum and Minimum Set Point

If the external or internal set point (SP) exceeds the maximum set point value, the SP is set to the maximum set point value; if the SP is less than the minimum set point, the SP is set to the minimum set point.

2.28.4.8. Set Dead Band on Deviation

If the e[k] is less than the dead band, the controller cannot tune the output.

2.28.4.9. Set the Maximum Output Change Rate

After tuning, if the change rate in sample (dCV[k]/T) exceeds the maximum output change rate, then the dCV[k] equals to the maximum output change rate * T.

2.28.4.10. Feed Forward for Disturbance Compensation

When FeedForwardEn (FF) is set to TRUE, the FFValue (FFV) will be added to the output of the PID algorithm.

2.28.5 Usage

2.28.5.1. Single Loop

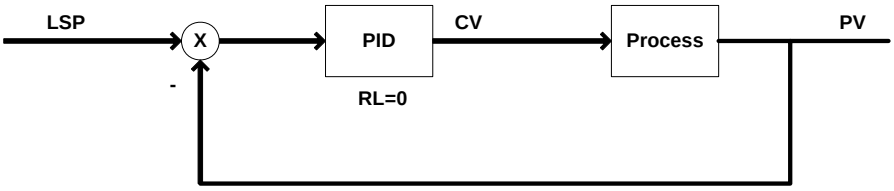


Figure 23 Single Loop

If AtMn is Manual mode, SPO = PV;
If AtMn is Automatic mode, MnVo = CV;
If use track, LSP should be equal to SPO, MnV should be equal to MnVo.

2.28.5.2. Cascade Control

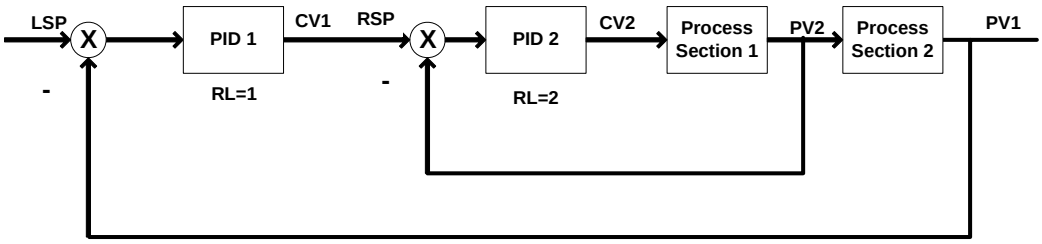


Figure 24 Cascade Control

PID1: Outer loop
SPV1 = PV2;
If AtMn1 and SAM1 are both Manual mode, MnVo1 = SPV1;

PID2: Inner loop

2.28.6 Track Output Mode Algorithm

```
IF Mode == MANU_MODE THEN
    IF OldMode == AUTO_MODE THEN
        MnVO =CV;
        OldMode = MANU_MODE;
    ELSE
        IF RmtLoc == OUTER_LOOP AND SAM == MANU_MODE THEN
            MnVO = SPV;
        ELSE
            MnVO = MnV;
        ENDIF
    ENDIF
    SPO = PV;
    CV = MnV;
ENDIF
IF Mode == AUTO_MODE THEN
    IF OldMode == MANU_MODE THEN
        OldMode = AUTO_MODE;
    ENDIF
      MnVO = CV;
    SPO = LSP(in single loop or the outer loop in multi loop);
    or SPO = RSP(the inner loop in multi loop)
ENDIF
```

3 Hints, Tips, and Frequently Asked Questions

Q: What are ParamReader and ParamWriter?
A: Both ParamReader and ParamWriter can access another function block's internal parameters. Currently ParamReader and ParamWriter could access the following function blocks:

1) Addition
2) BCA
3) Characterizer
4) DEB400
5) DemandLimit
6) Divider
7) LeadLag
8) Multiply
9) Participation
10) PID
11) Runback
12) Servo
13) Switch

Q: How do you control a function block's output when the operation mode is switched from Auto to Manual mode?
A: When a Function Block Operation Mode (MODE) is switched from Auto to Manual mode, the output (AO) will retain at the last cycle Auto mode output value. Then the user could adjust the AO in Manual mode using the Manual Output Percentage (MOP).

Q: Does the Manual Output Percentage (MOP) function in Auto mode?
A: Yes. When a function block is in Manual mode, the user could use MOP to adjust the output (AO) value. When a function block is in Auto mode, MOP will display the most updated output percentage which is however not accessible to users.

Appendix A Product Support

Warranty Information

All MOX manufactured products are warranted to be free from defects in material and workmanship. Our obligation under this warranty will be limited to repairing or replacing, at our option, the defective parts within 1 year of the date of installation, or within 18 months of the date of shipment from the point of manufacture, whichever is sooner. Products may only be returned under authorization. The purchaser will prepay all freight charges to return any products with a valid return authorization number to the designated repair facility.

This limited warranty does not cover loss or damage that may occur in shipment of the goods or due to improper installation, maintenance, misuse, neglect or any cause other than ordinary commercial or industrial use. This limited warranty is in lieu of all other warranties whether oral or written, expressed or implied.

Liability associated with all MOX products shall not exceed the price of the individual unit that is the basis of the claim. In no event will there be liability for any loss of profits, loss of use of facilities or equipment or other indirect, incidental or consequential damages.

Contact Details

To obtain support for MOX products, call MOX Group on the following numbers, or your designated support provider and ask for MOX Support.

E-mail Addresses

support@mox.com.au

sales@mox.com.au

Visit Our Web Page at

http://www.mox.com.au

Service Information

If you require service, contact your local MOX Group representative. A trained specialist will help you to quickly determine the source of the problem. Many problems are easily resolved with a single phone call. If it is necessary to return a unit, an RMA (Return Material Authorization) number will be provided.

All returned materials are tracked with our RMA system to ensure speedy service. You must include this RMA number on the outside of the box so that your return can be processed immediately.

Your MOX Group authorized applications engineer will complete an RMA request for you. If the unit has a serial number, we will not need detailed financial information. Otherwise, be sure to have your original purchase order number and date purchased available.

We suggest that you provide a repair purchase order number in case the repair is not covered under our warranty. You will not be billed if the repair is covered under warranty.

Please supply us with as many details about the problem as you can. The information you supply will be written on the RMA form and supplied to the repair department before your unit arrives. This helps us to provide you with the best service, in the fastest manner. Most repairs are completed within two days. During busy periods, there may be a longer delay.

If you need a quicker turnaround, ship the unit to us by airfreight. We give priority service to equipment that arrives by overnight delivery. Many repairs received by midmorning (typical overnight delivery) can be finished the same day and returned immediately.

We apologize for any inconvenience that the need for repair may cause you. We hope that our rapid service meets your needs. If you have any suggestions to help us improve our service, please give us a call. We appreciate your ideas and will respond to them.

For Your Convenience:

Please fill in the following information and keep this manual with your MOX system for future reference:

P.O. #: _____ Date Purchased: _____

Purchased From: _____

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