

SPEED LOOP – RG355564

Use this block to tune the speed loop PI to produce a current demand.

This function block has five main functions:

MMI Menu Map

1	SETUP PARAMETERS
2	SPEED LOOP
	SPD.PROP.GAIN
	SPD.INT.TIME
	INT. DEFEAT
	PRESET TORQUE
	PRESET T SCALE
	SPEED FBK SELECT
	ENCODER SIGN
	SPD.FBK.FILTER
>>	ADVANCED
>>	SETPOINTS

1. **Combining the 4 speed setpoints into a single speed setpoint.**

Note that the speed demand is created from the combined speed setpoints and modified by any prevailing stop condition according to the STOP RATES function block settings.

2. **Selection of the speed feedback method.**

ZERO SPD OFFSET from the CALIBRATION function block is applied to the selected speed feedback to null out any remaining feedback at zero actual speed.

3. **Implementation of the PI speed controller.**

SPEED DEMAND is summed algebraically with SPEED FEEDBACK to produce SPEED ERROR. When the drive is enabled, SPEED ERROR is controlled by the PI loop. The resulting current demand signal is routed to the CURRENT LOOP function block and to the ADVANCED::ZERO SPD. QUENCH sub-menu.

The PI output is accessible via Tag No. 356, TOTAL I DMD. This point is before the I Limit clamps and the summing of the additional current demand. (This tag is not visible on the MMI).

4. **Speed controller gain and integral time constant profiling with speed.**

The gains change when the motor speed feedback reaches the thresholds set by SPD BRK 1 (LOW) and SPD BRK 2 (HIGH).

- At or below SPD BRK 1 (LOW), the speed loop uses the PROP. GAIN and INT. TIME CONST. values as its PI loop gains.
- Between SPD BRK 1 (LOW) and SPD BRK 2 (HIGH), profiling occurs and the speed loop gains are determined by another parameter value (according to the selection of the MODE parameter).
- Above SPD BRK 2 (HIGH), the SPD. PROP. GAIN and SPD. INT. TIME settings are used.

MODE selects the parameter for profiling the speed loop PI gains when the motor speed is between the two speed breakpoints.

FUNCTION BLOCKS MOTOR CONTROL SPEED LOOP

	SPEED ERROR FILTERED	[297]	0.00 %
	SPEED LOOP O/P	[549]	0.00 %
	SPEED DEMAND	[89]	0.00 %
	UNFIL.SP.D.FBK	[62]	0.00 %
	SPEED SETPOINT	[63]	0.00 %
	UNFIL.SP.D.ERROR	[64]	0.00 %
	SETPOINT 2 (A3)	[290]	0.00 %
10.00	-	[14] SPD PROP GAIN	
0.500 s	-	[13] SPD INT TIME	
OFF	-	[202] INT. DEFEAT	
0.000	-	[547] SPD.FBK.FILTER	
0.00 %	-	[289] SETPOINT 1	
POSITIVE	-	[9] SIGN 2 (A3)	
1.0000	-	[7] RATIO 2 (A3)	
0.00 %	-	[291] SETPOINT 3	
0.00 %	-	[41] SETPOINT 4	
105.00 %	-	[357] MAX DEMAND	
-105.00 %	-	[358] MIN DEMAND	
0.00 %	-	[595] PRESET TORQUE	
100.00 %	-	[604] PRESET T SCALE	
DISABLED	-	[268] MODE	
1.00 %	-	[269] SPD BRK1 (LOW)	
5.00 %	-	[270] SPD BRK2 (HIGH)	
5.00	-	[271] PROP. GAIN	
0.500 s	-	[272] INT TIME CONST	
1.0000	-	[274] I GAIN IN RAMP	
0.50 %	-	[284] ZERO SPD. LEVEL	
1.50 %	-	[285] ZERO IAD LEVEL	
ARM VOLTS FBK	-	[47] SPEED FBK SELECT	

MMI Menu Map

1	SETUP PARAMETERS
2	SPEED LOOP
3	SETPOINTS
	SETPOINT 1
	SIGN 2 (A3)
	RATIO 2 (A3)
	SETPOINT 2 (A3)
	SETPOINT 3
	SETPOINT 4
	MAX DEMAND
	MIN DEMAND

MMI Menu Map

1	SETUP PARAMETERS
2	SPEED LOOP
3	ADVANCED
>>	ADAPTION
>>	I GAIN IN RAMP
>>	ZERO SPD. QUENCH

5. Zero speed/current disabling of thyristor firing

The current loop is disabled when SPEED DEMAND, SPEED FEEDBACK and CURRENT DEMAND have all dropped to the threshold levels set by ZERO SPD. LEVEL and ZERO IAD LEVEL.

This is similar to Standstill logic (it stops making current but the contactor stays energised) except that the speed loop remains enabled and this will cause the current loop to unquench very quickly.

MMI Menu Map

1	SETUP PARAMETERS
2	SPEED LOOP
3	ADVANCED
4	ADAPTION
	MODE
	SPD BRK 1 (LOW)
	SPD BRK 2 (HIGH)
	PROP. GAIN
	INT.TIME. CONST

SPEED LOOP

Parameter	Tag	Range
SPD PROP GAIN Speed loop PI proportional gain adjustment.	14	0.00 to 200.00
SPD INT TIME Speed loop PI integral gain adjustment.	13	0.001 to 30.000 s
INT. DEFEAT When ON it inhibits the integral part of the speed loop PI control to give proportional only control.	202	OFF / ON
SPEED FBK FILTER (SPD.FBK.FILTER) A simple filter function that is applied to speed feedback to reduce ripple caused by low line count encoders and noisy tachos. A value of 0 disables the filter action ,and 1.00 is the maximum value. A typical value would be between 0.5 and 0.75. INCREASING THE FILTER VALUE MAY MAKE THE SPEED LOOP UNSTABLE. The filter time constant τ in milliseconds can be calculated from the following equation:	547	0.000 to 1.000
$\tau = \frac{3.3}{\text{Log}_e\left(\frac{1}{\alpha}\right)}$		
Where α is the value of SPD FBK FILTER. A value of 0.5 equates to a filter time of 4.8ms, 0.8 to 14.7ms, and 0.9 to 31.2ms.		
SETPOINT 1 Speed Setpoint 1 (Default Setpoint Sum 1 O/P).	289	-105.00 to 105.00 %
SIGN 2 (A3) Speed Setpoint 2 Sign.	9	NEGATIVE / POSITIVE

MMI Menu Map

1	SETUP PARAMETERS
2	SPEED LOOP
3	ADVANCED
4	ZERO SPD. QUENCH
	ZERO SPD. LEVEL
	ZERO IAD LEVEL

SPEED LOOP

Parameter	Tag	Range
RATIO 2 (A3) Speed Setpoint 2 Ratio.	7	-3.0000 to 3.0000
SETPOINT 3 Speed Setpoint 3 (Default Ramp O/P).	291	-105.00 to 105.00 %
SETPOINT 4 Speed Setpoint 4 (Default 5703 I/P).	41	-105.00 to 105.00 %
MAX DEMAND Sets the maximum input to the speed loop. It is clamped at 105% to allow for overshoot in the external loops.	357	0.00 to 105.00 %
MIN DEMAND Sets the minimum input to the speed loop.	358	-105.00 to 105.00 %
PRESET TORQUE The PRESET TORQUE is pre-loaded into the speed loop integral store as the speed loop is enabled. This is scaled by PRESET T SCALE. This may be used to pre-load the output of the speed loop in elevator/hoist applications to prevent the load from falling back when the brake is released. PRESET T SCALE may be used in situations where the load may vary.	595	-200.00 to 200.00 %
PRESET T SCALE Scaler for PRESET TORQUE.	604	-200.00 to 200.00 %
MODE Selects the speed breakpoint input signal. 0 : DISABLED 1 : SPD FBK DEP Speed Feedback Dependent 2 : SPD ERR DEP Speed Error Dependent 3 : CUR DMD DEP Current Demand Dependent	268	See below
SPD BRK 1 (LOW) Speed breakpoint 1 to start gain profiling.	269	0.00 to 100.00 %
SPD BRK 2 (HIGH) Speed breakpoint 2 to stop gain profiling.	270	0.00 to 100.00 %

SPEED LOOP

Parameter	Tag	Range
PROP. GAIN	271	0.00 to 200.00
Proportional gain used below SPD BRK 1 (LOW)		
INT. TIME CONST.	272	0.001 to 30.000 s
Integral time constant used below SPD BRK 1 (LOW)		
I GAIN IN RAMP	274	0.0000 to 2.0000
This scales the integral gain when the drive is ramping. When RAMPING (Tag No. 113) is TRUE, the integral gain from ADAPTION is switched through the I GAIN IN RAMP scaler. This can be used to help prevent integral wind-up while the drive is ramping (particularly high inertia loads).		
ZERO SPD. LEVEL	284	0.00 to 200.00 %
Sets the threshold of SPEED DEMAND and SPEED FEEDBACK for suspending the current output.		
ZERO IAD LEVEL	285	0.00 to 200.00 %
Sets the current demand threshold for suspending the current output.		
SPEED ERROR FILTERED	297	—.xx %
<i>Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).</i>		
SPEED LOOP O/P	549	—.xx %
<i>Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).</i>		
SPEED DEMAND	89	—.xx %
<i>Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).</i>		
UNFIL.SP.D.FBK	62	—.xx %
<i>Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).</i>		
SPEED SETPOINT	63	—.xx %
<i>Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).</i>		
UNFIL.SP.D.ERROR	64	—.xx %
<i>Refer to Chapter 6: "The Keypad" - The Keypad Menus (DIAGNOSTICS).</i>		
SETPOINT 2 (A3)	290	—.xx %
Speed Setpoint 2 - Fixed (non-configurable) setpoint scanned synchronously with the current loop		

SPEED LOOP

Parameter	Tag	Range
SPEED FBK SELECT	47	See below
<p>Determines the source of the speed feedback signal. The default, ARM VOLTS FBK, uses internal circuitry to derive the speed feedback. The other selections require the appropriate external device to provide the feedback signal.</p> <p>0 : ARM VOLTS FBK 1 : ANALOG TACH 2 : ENCODER – Associated with the Encoder Feedback Option card. 3 : ENCODER/ANALOG - for Parker SSD Drives use 4: ENCODER 2 – Associated with Digital Input 2 (terminal C7) and Digital Input 3 (terminal C8)</p>		

Functional Description

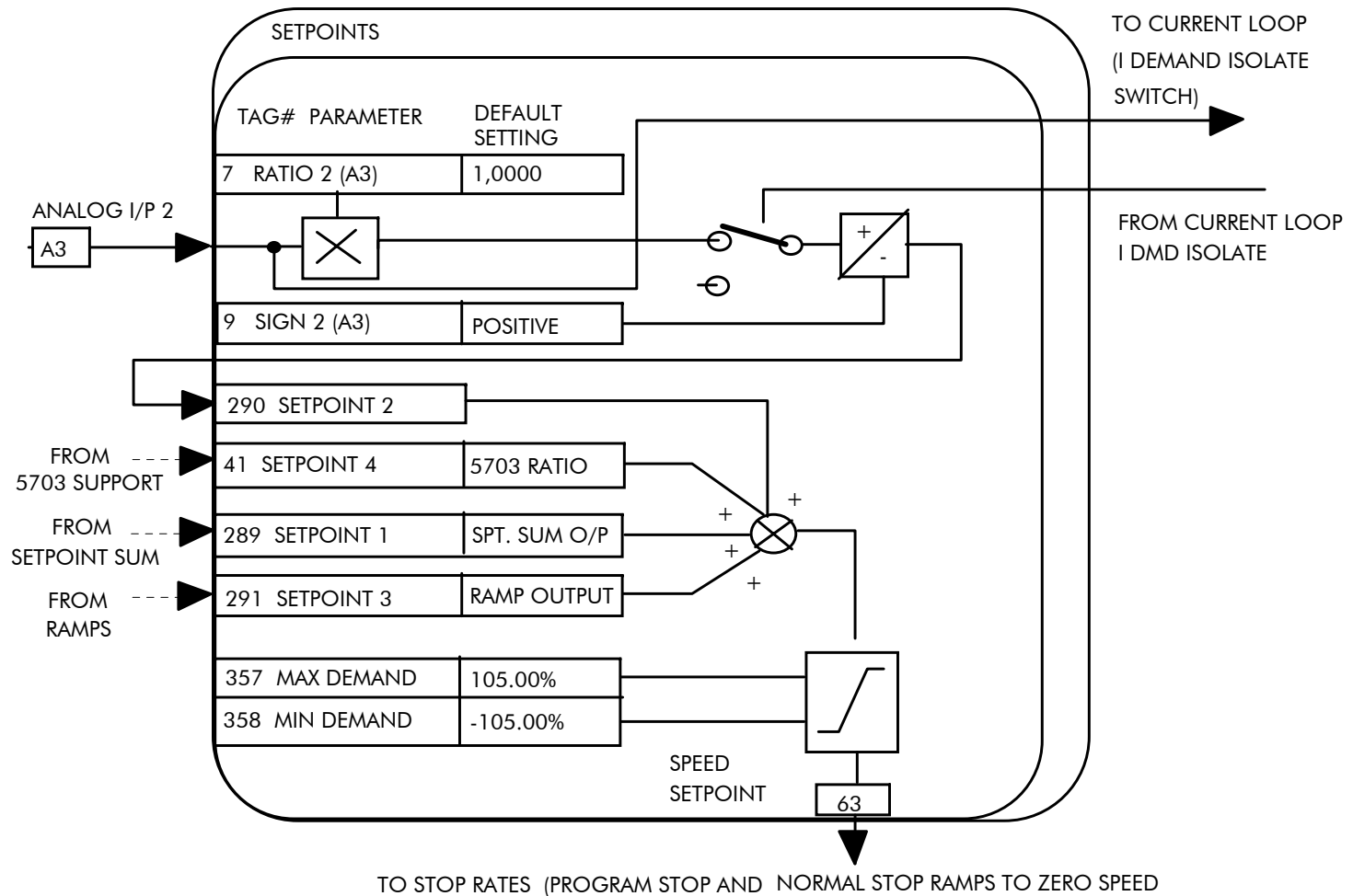
Speed Loop PI with Current Demand Isolate

The speed loop output is still valid (active) with the I DMD. ISOLATE parameter enabled.

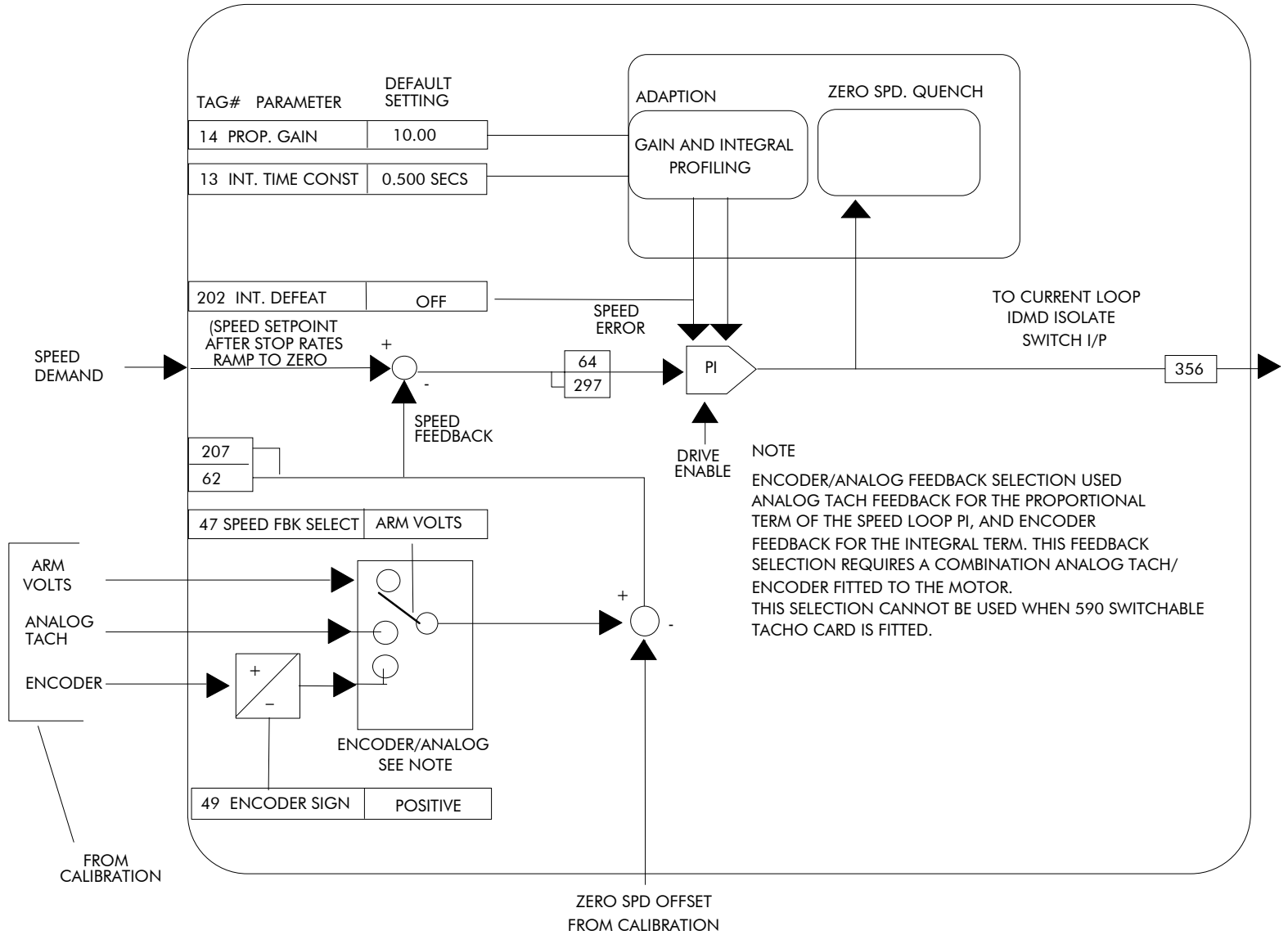
- NOTE**
- 1** The speed loop is reset by unquenching the speed loop/current loop.
 - 2** I DMD. ISOLATE is overridden by Program Stop (B8) or Normal Stop (C3).
 - 3** The speed loop PI holds the integral term as soon as the PI output reaches current limit. This is true even in Current Demand Isolate mode where it may interfere depending on the way the speed PI is used. This feature is currently not suppressible.

105% Speed Demands

The speed demand clamping allows the speed setpoint to reach 105%. This applies only to the final summing junction immediately before the speed loop and also to the Setpoint Sum 1 output. Individual speed setpoints are still clamped to 100%.



SPEED LOOP



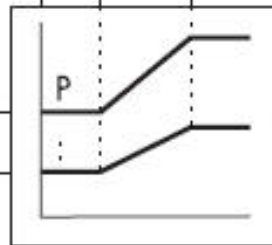
From Speed Loop
Int. Time Constant
Prop. Gain

ADAPTION

Tag #	Parameter	Default Setting
270	Spd Brk2 (High)	5.00%
269	Spd Brk1 (Low)	1.00%
268	Mode	0

Adaption Mode
 0 Disabled
 1 Speed Feedback Dependent
 2 Speed Error Dependent
 3 I Demand Dependent

271	Prop. Gain	5.00
272	Int. Time Const.	0.500 Secs

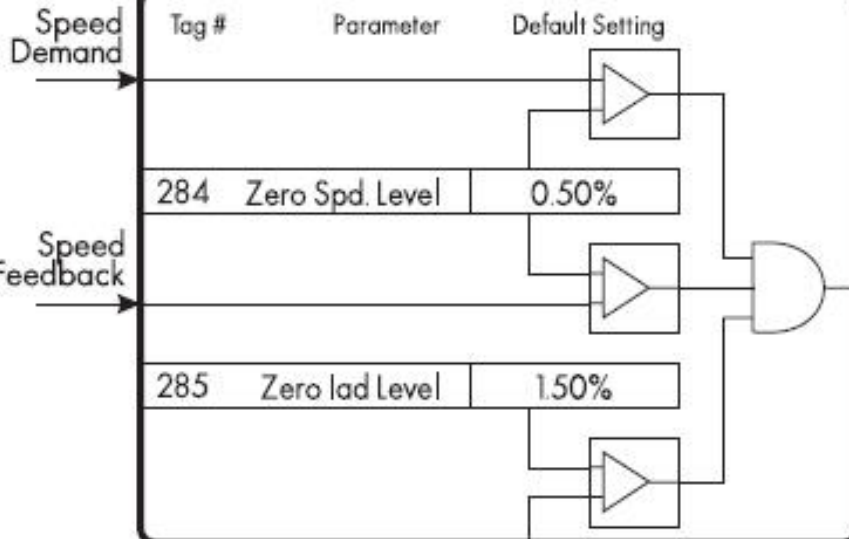


274	I Gain In Ramp	10000
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Ramping
From Ramps

ZERO SPD. QUENCH



Armature SCR
Firing Quench

Current Demand
From Speed Loop

To Speed Loop PI

KEY
 —→ Non-configurable * Filtered Tag
 - - → Configurable D:nn Diagnostic #