

SERIES 1|S

SLEW LIMITER



INSTALLATION MANUAL

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CONTENTS

	Page
1 INTRODUCTION	4
1.1 Overview	4
1.2 Display mounting	4
2 SLEW MODULE MOUNTING	5
2.1 Motion cut solenoids	5
3 PROXIMITY SWITCHES (TOOTH COUNTING)	6
3.1 Proximity Switch Installation - clearance	6
3.2 Tooth Count Proximity Switch Spacing	7
3.3 Reset proximity switch	7
4 SYSTEM LAYOUT	8
5 SLEW MODULE CONNECTION TABLE	9
6 SLEW MODULE CONNECTIONS	10
6.1 +V and 0V Supply to slew module	10
6.2 Motion cut solenoid valve connections	10
6.3 Proximity sensor connections	10
7 TESTING THE INSTALLATION	11
8 CHECKING THE TOOTH COUNT SEQUENCE	12
9 CALIBRATION	13
10 GUIDE TO KEY SWITCH / LED MODES	14

1 INTRODUCTION

This manual contains the installation instructions for the Series 1-S slew limiting system.

Installation should only be carried out by competent and trained staff as this product is a safety product.

During installation it is assumed that industry standards will be observed and all cabling will be protected against damage either from the movement of the machine or from collisions that may occur during normal operations (trees & branches, etc.).

All welding or bare metalwork should be treated to ensure that rust does not form.

1.1 Overview

Series 1-S is a stand alone slew limiter intended for use on hydraulic excavators and similar machines where an upper structure rotates relative to the base structure, and where slew limits are required.

Series 1-S monitors the slew position of the machine by means of counting of the teeth on the slew ring, and limits the slew movement of the machine to between two slew points which are set by the machine operator.

Pre-emptive stop algorithms will monitor the speed of approach to the limit and will progressively apply the motion cut earlier the faster the speed of approach, ensuring the machine stops before the limit is breached.

The Series 1-S system consists of an in cab display mounted at the operator station and external slew module.

Communication between the slew module and the display is by means of a 4 connection CAN cable with 12mm screw connectors at each end.

The slew module has two 12 way Deutsch connectors for connection to +V and OV, three proximity switches (slew ring tooth counting and reset), and two motion cut outputs for connection to solenoid valves to motion cut the slew left and slew right controls.

1.2 Display mounting

The in cab display should be mounted at the operator station in direct line of sight of the operator and should be positioned so the machine operator can easily reach the device. A RAM type swivel mount is provided to enable the device to be orientated towards the operator. Mount the bracket to a firm surface in the cab, bearing in mind the loads likely to be imposed on the mount by vibration and movement.

Ensure that no machine controls are obscured, and that windows, doors and access panels can be opened and closed without fouling the Series 1-S display..

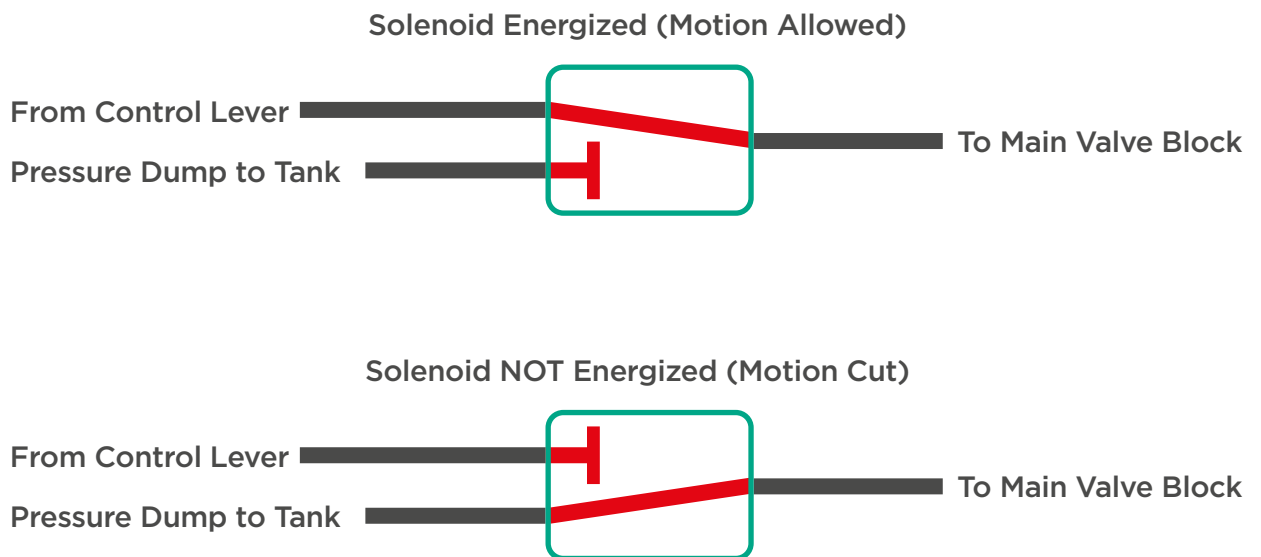
2 SLEW MODULE MOUNTING

The slew module should be mounted in a position where it is protected from direct rainfall and jet washing etc, and where it is unlikely to be damaged mechanically. It is useful if the LEDs within the module can be seen to assist in setup and fault finding. The slew module may be mounted in any orientation. Ideally it should be fixed to a suitable panel using the two mounting lugs and suitable 6mm bolts.

2.1 Motion cut solenoids

Two motion cut solenoid valves are typically used, to cut motion to the slew left and slew right circuits. The motion cut valves are typically mounted in the pilot circuit between the hydraulic controls of the machine and the main valve block, and should cut pilot pressure to the valve block when not energized, and allow normal operation when energized.

The solenoid valves should be installed in the pilot control line to the slew left and slew right hydraulic circuits, and should connect the control levers to the valve block when energized. When not energized (motion cut) the supply from the control levers must be blocked and the line to the high pressure valve block must be connected to tank to dump any residual pressure, thus cutting motion.



3 PROXIMITY SWITCHES (TOOTH COUNTING)

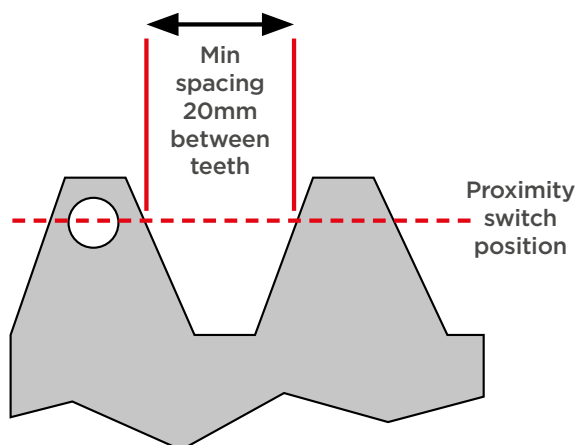
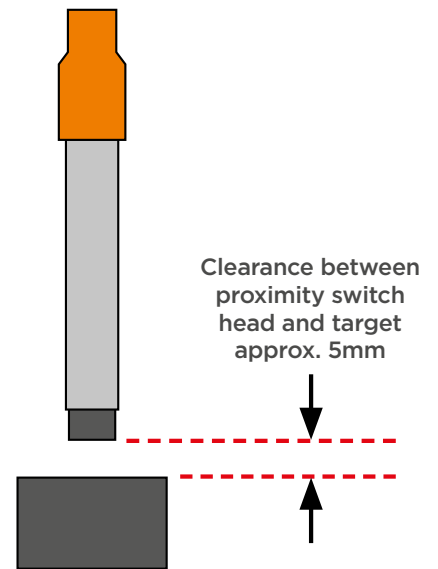
Two proximity switches must be installed in such a way as to count the movement of the upper structure against the slew ring teeth. The teeth are typically accessed through an inspection hatch, and it is usually possible to mount the proximity switches into the inspection plate so that they are able to detect the slew ring teeth as they pass beneath. It is possible that a custom bracket may need to be fabricated to hold the proximity switches in a position where the slew ring teeth may be counted. Where no access to the slew ring teeth is possible, an external toothed ring may be fitted as a register.



It may also be possible to count the bolts holding the slew assembly together, although this solution generally provides a lower count resolution, which is less desirable.

3.1 Proximity Switch Installation - clearance

The proximity switches must be installed so that the clearance between the sensor head and the target being detected is approximately 5mm. The proximity switches have a maximum detection distance of 8mm.



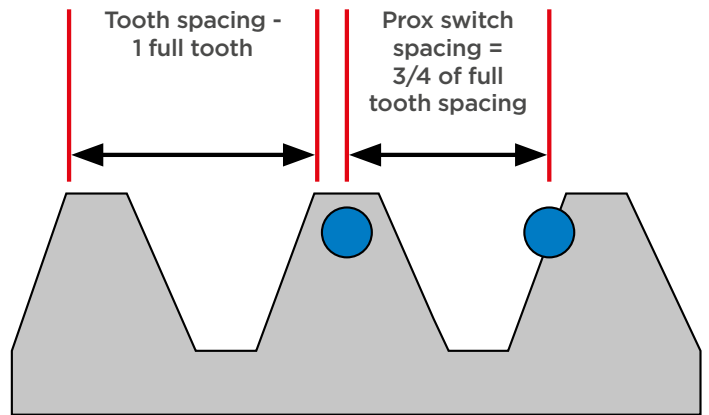
When determining the position for installation of the two tooth counting sensors, ensure that there is at least 20mm of clear space between teeth as they are seen by the proximity switches. This clearance is important because the proximity switch needs to have a period between teeth where no tooth is detected

3.2 Tooth Count Proximity Switch Spacing

The tooth counting proximity switch spacing is important, as by the sequence of switches detecting teeth, the Series 1-S is able to determine the direction of slew.

The proximity switches must be mounted 90 degrees out of phase, or in other words, the spacing between the two switches should be 75% of the full tooth spacing, as shown in the diagram alongside.

The detection of teeth by the switches can be monitored by looking at the LEDs within the slew module associated with Input 1 and Input 2. These LEDs can be seen through the orange translucent cover of the module.



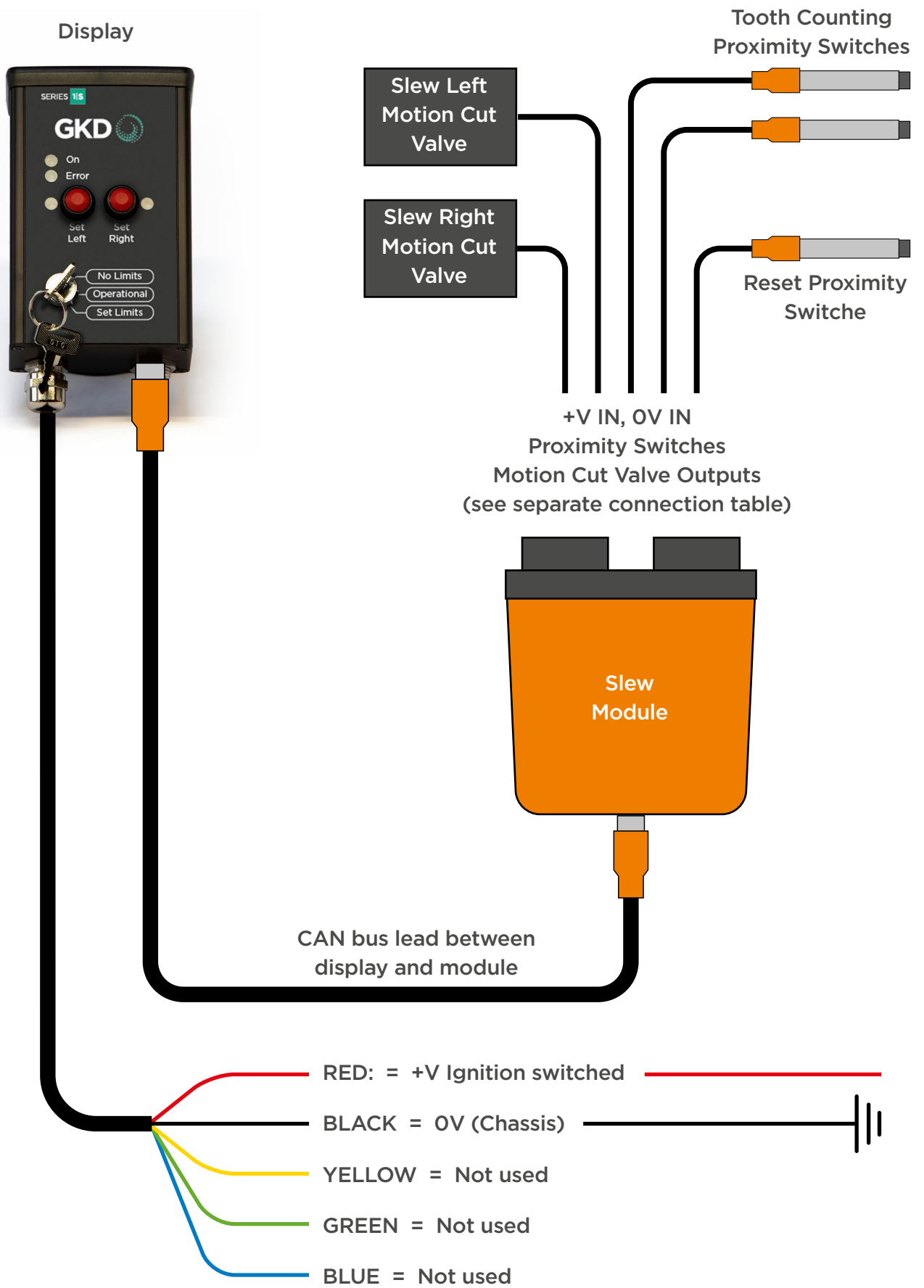
When registered on the slew module LEDs (input 1 and input 2) as the machine slews, there must be a period when both prox switch LEDs are OFF. One LED should come on, then the second (both ON together) then first one off, then second one off (both OFF together). This sequence is important, if necessary adjust the spacing between the two proximity switches to achieve this sequence.

3.3 Reset proximity switch

The third proximity switch is a Reset switch. The reset switch should be mounted in such a way as to be momentarily triggered by a suitable target as the machine passes over 0 degrees of slew (upper structure in line with the undercarriage over the front end)..

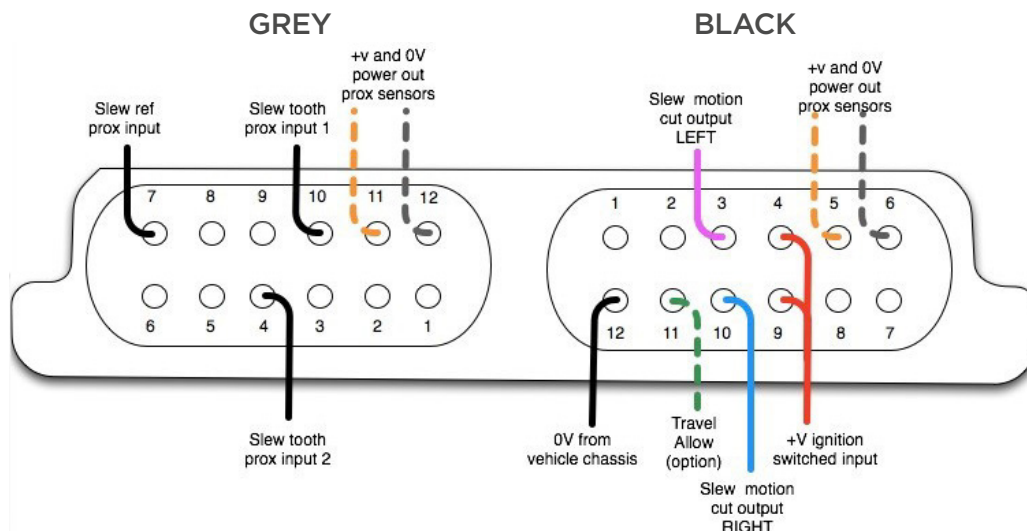


4 SYSTEM LAYOUT



5 SLEW MODULE CONNECTION TABLE

Grey	Black	Function	
1		Not used	
2		Not used	
3		Not used	
4		Slew proximity switch 2	Slew tooth count proximity switch 2 input
5		Not used	
6		Not used	
7		Slew Reference switch	Slew reference proximity switch input
8		Not used	
9		Not used	
10		Slew proximity switch 1	Slew tooth count proximity switch 1 input
11		POS +24V supply OUT	+V out for proximity switches
12		0V OUT	0V out for proximity switches
	1	Not used	
	2	Not used	
	3	Slew Motion Cut Left	+V output to solenoid valve
	4	POS +24V supply IN	Switched by ignition and protected by a 5A Fuse
	5	POS +24V supply OUT	+V out for proximity switches
	6	0V OUT	0V out for proximity switches
	7	Not used	
	8	Not used	
	9	POS +24V supply IN	Switched by ignition and protected by a 5A Fuse
	10	Slew Motion Cut Right	+V output to solenoid valve
	11	Travel Allow Output	+V output. Cuts travel when slew limits are active
	12	0V IN	0V input, connect to chassis (ground)



6 SLEW MODULE CONNECTIONS

6.1 +V and 0V Supply to slew module

The slew module internal electronics are powered through the 12mm CAN bus connector from the display. The solenoid valves driven from the slew module derive their power from the +V inputs into the slew module deutsch connectors (black connector, pins 4 and 9). If the total current draw of the two solenoid valves is less than 5A it is not necessary to connect both pins 4 and 9 to +V, only one (either one of the two) needs to be connected. The external power supply to the module should be connected to an ignition switched supply, and fused. A 5A fuse is recommended on a 24V machine, a 10A fuse will be required for a 12V machine.

The black connector, pin 12 should be connected to 0V, a direct connection to the vehicle chassis is recommended.

6.2 Motion cut solenoid valve connections

The two motion cut valves are connected to the Slew module as per the table on the previous page. The slew module provides +V out to the solenoids when slew movement is allowed, and cuts the +V output to each valve individually when motion cut is required.

The 0V connection to each motion cut solenoid should be directly to the vehicle chassis.

6.3 Proximity sensor connections

The cables from the proximity switches should have their insulation removed at the connection end to expose the internal coloured wires.

For each switch the brown, blue and black wires are used, the white wire is not used and can be cut back.

- > **BROWN** = +V
- > **BLUE** = 0V
- > **BLACK** = SIGNAL

The **BROWN** wires from all three sensors should be combined and powered from an ignition switched power source. This can be from the same power source as the +V input to the module.

Alternatively, the proximity switches can be powered from GREY pin 11 and BLACK pin 5 on the slew module deutsch connectors. Please note that the power source from the module (grey 11 / black 5) is a low current power source, do not connect anything else to these pins.

The **BLACK** wires from the three proximity switches should be connected individually to the appropriate inputs on the Slew module deutsch connectors, as per the connection table on the previous page.

The **BLUE** wires from all three sensors should be combined and connected to an external chassis ground, or alternatively to GREY pin 12 and BLACK pin 6 on the slew module deutsch connectors.

7 TESTING THE INSTALLATION

Once installation has been completed, turn the ignition on and check that the green **“ON”** LED lights to signify power. The red **“FAULT”** LED will blink slowly (1 sec ON, 1 sec OFF) with the key switch in the **“No Limits”** position, as the module has not yet learned the number of teeth on the slew ring. Turning the key switch to **“operational”** or **“Set Limits”** should cause the red Fault lamp to go out.

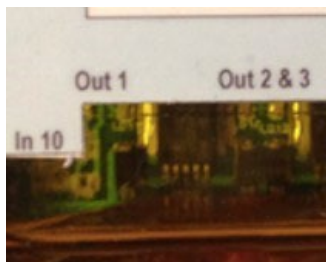
If the **“FAULT”** LED blinks very slowly (3 seconds ON, 3 seconds OF) with the key switch in all positions, a CAN bus fault between the display and module is likely. Check the CAN bus connections to the slew module.

Check that the green LED marked **“EXT V+”** is ON, this shows that the external +V supply to the module through the deutsch connectors is working. The green LED marked **“V In”** should also be ON, this LED shows that power is being received from the display through the CAN bus lead.



+V input - CANbus - also powers proximity switches

+V input for solenoid outputs - derived from deutsch connector +V inputs



Check also that the two LEDs corresponding with Out 1 (Output 1) and Out 2 (Output 2) are on - these will be on when the solenoid valves for slew left and slew right motion cut are powered.

Turn the key switch on the display to **“NO LIMITS”**.

If safe to do so, operate the machine slew to rotate the upper structure SLOWLY, and observe the slew module LEDs associated with Inputs 1,2 and 3.

Inputs 1 and 2 should be flashing on and off regularly as teeth are counted by the proximity switches mounted against the slew ring, and the sequence of the two LEDs should be LED1 ON - LED2 ON (both on together) - LED1 OFF (LED2 still on), LED2 off (both off together). When the direction of slew is reversed, the sequence will reverse.

Slew the machine over 0 degrees, LED3 should light up momentarily as the reset switch is triggered.

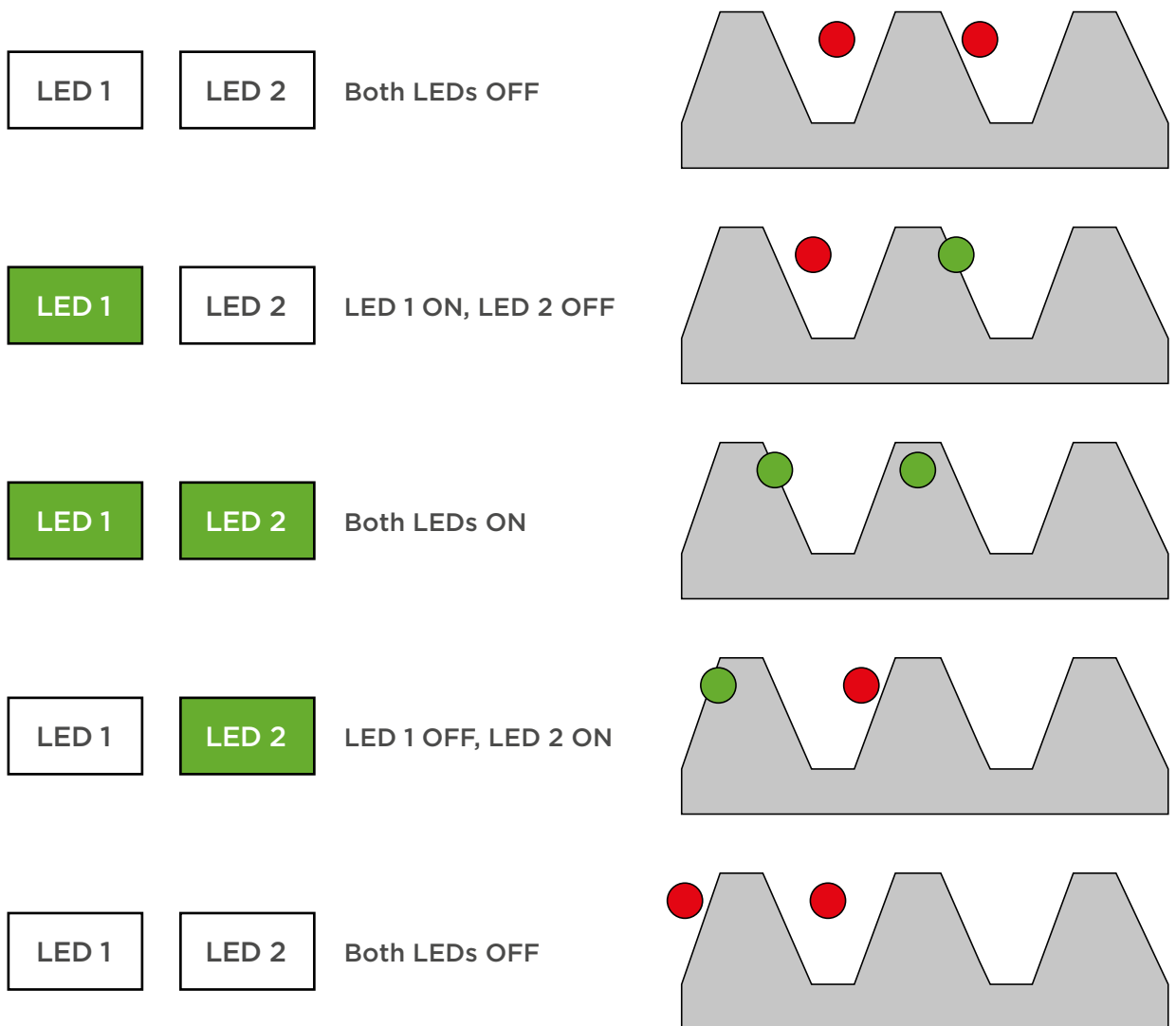
8 CHECKING THE TOOTH COUNT SEQUENCE

Identify the LEDs associated with input 1 and input 2. The LEDs can be identified from the label on the module. The input 1 and 2 LEDs will light up when a slew tooth is detected by the two tooth counting proximity switches. The LED associated with Input 3 will light up over 0 degrees of slew when the slew reset proximity switch detects the target post over 0 degrees.



LEDs for proximity switch inputs:
In1 / In2 / In3

Slowing slowly at a constant speed, check the sequence of the two LEDs identified as In1 and In2 as the teeth are counted. The sequence should be as follows:



Note that the sequence will be reversed as the direction of slew reverses - in other words LED2 will come on first, then LED1, then LED2 will go out, then LED1 will go out.

9 CALIBRATION

The following procedure highlights the process required to teach the Slew Module the number of teeth it will be counting on a slew ring or similar counting setup. It is assumed at this point that there is no CAN Bus errors and the Series 1-S is indicating a state of No Slew Data.

- 1) Switch the key-switch is in the “No Limits” position.
- 2) Position the turret so that the slew reset block is to one side of the slew reset sensor - in other words, not over the reset position.
- 3) Press and hold both limit buttons together.
- 4) The left & right limit LED’s will alternate between yellow for a second and off for a second.
- 5) Wait for 10 seconds until the left and right limit LED’s stay on Yellow.
- 6) While still holding both limit buttons, switch the key-switch to the “Operational” then “Set Limits” position.
- 7) Release the two limit buttons.
- 8) The left & right limit LED’s will alternate between red for 1/5 of a second and green for 1/5 of a second.
- 9) Slew the turret through the slew reset position and then continue to slew at a constant speed for a further 2 complete revolutions.
- 10) If the Error LED comes on flashing at 1/5 of a second then the Learn mode has detected a fault, return to step 1 and. Ensure the vehicle is rotated in the same direction without stopping.
- 11) After the 2 full revolutions the left & right limit LED’s will come on Red only.
- 12) This completes teeth counting with the slew module.

Once the calibration procedure above has been completed, turn the key switch to the “**SET LIMITS**” position, and set Left and Right slew limits by moving the machine slew to the desired limit position and pressing the “**SET LEFT**” or “**SET RIGHT**” button as appropriate.

Turn the key switch to the “**OPERATIONAL**” position and slew towards each limit. The Series 1-S SlewGuard

system should cut the slew hydraulic function as the limit is approached, but allow the slew to operate back to the “safe” zone between the limits. As the speed of approach to the limit increases, the Series 1-S should cut the slew function progressively earlier to ensure that the machine stops before the limit is reached, without overshooting the limit.

NOTE: Should the Series 1-S cut the slew very early and not allow the limit to be approached, it is possible that the signals from the two tooth counting sensors need to be reversed.

10 GUIDE TO KEY SWITCH / LED MODES

R = RED

Y = Yellow (Red / Green together)

G = Green

O = OFF

S = Static colour only

T = Toggles between colours

Key Switch	LEDs			Comment
	Fault (R)	Left Limit	Right Limit	
All	S	Test	Test	Along with the buzzer this is the standard start up test mode and will show the fault LED for a short time while communications is established with the Slew Module.
All	3 Sec/TO	O	O	No detected Slew Module or the CAN Bus is in fault due to no connected devices or a wiring/component issue.
No Limits	1 Sec/TO	GS	GS	The Slew module is reporting there is no slew teeth data and can not operate accordingly, Slew Cuts will be enabled.
Operational / Set Limits	O	3 Sec/YTO	3 Sec/YTO	The Slew module is reporting there is no slew teeth data and can not operate accordingly, Slew Cuts will be disabled.
All	1/5 Sec/TO	Ignore	Ignore	The Slew module is reporting an error, retesting of limits is recommended. To cancel the error condition, switch the keyswitch to the "No Limits" position then test for correct functionality of the system and limits. This could be caused by miscalculation of the slew teeth, adjust the sensor positions or an attempt to learn a slew teeth count and reversing direction before the end of the learn process.
All	O	Ignore	Ignore	No detected faults, slew cuts will be dependent on mode set by the keyswitch.
No Limits	Ignore	1 Sec/YTO	1 Sec/YTO	Learn slew teeth mode stage 1, both limits button should be pressed to cause this.
No Limits	Ignore	YS	YS	Learn slew teeth mode stage 2, with both limit buttons held the keyswitch can be switched to "Set Limits". Slew Cuts will be enabled.
Operational	Ignore	YS	YS	Learn slew teeth mode stage 2, with both limit buttons held the keyswitch can be switched to "Set Limits". Slew Cuts will be disabled.
Operational	Ignore	1 Sec/RS	1 Sec/RS	Learn slew teeth mode stage 2, when one or both limit buttons is released, cancels the learn teeth mode.
Set Limits	Ignore	YS	YS	Learn slew teeth mode stage 2, when both limit buttons are release the learn slew teeth will change to mode 3. Slew Cuts will be enabled.
Set Limits	O	1/5 Sec/RTG	1/5 Sec/RTG	Learn slew teeth mode stage 3, Slew Cuts will be enabled, 2 complete revolutions in the same direction are required, passing the reset detector a total of 3 times to complete the mode.
Set Limits	1/5 Sec/TO	1/5 Sec/RTG	1/5 Sec/RTG	Learn slew teeth mode stage 3 detected an error, the direction of travel was reversed during one of the two revolutions, switch the keyswitch to the "No Limits" position and repeat. If repeated errors occur check the detector mark/ space ratio.
No Limits	O	GS	GS	Slew System may be used without limits, there is a known tooth and no errors are being detected. Slew Cuts will be enabled.
Operational	O	O	O	There is a known tooth count but no limits have been set yet, the slew cuts are kept disabled.
Set Limits	O	RS	RS	If either of the Limit LED's shows in red then there has never been a set limit in that direction, move vehicle to a suitable position and set one limit with its button then repeat for the other limit. Slew Cuts are enabled.
Set Limits	O	YS	GS or RS	Yellow LED lights while limit button is held, on release new limit set.
Set Limits	O	GS or RS	YS	Yellow LED lights while limit button is held, on release new limit set.
Set Limits	O	GS	GS	Both limits are set suitable for operational use. Slew Cuts are enabled.
Operational	O	GS	GS	Operating within accepted Slew Limits, Slew Cuts are active by Slew Module.
Operational	O	1/5 Sec/RTO	GS	Slew Limit reached at the left indicated position, Slew Left Cut disabled.
Operational	O	GS	1/5 Sec/RTO	Slew Limit reached at the right indicated position, Slew Right Cut disabled.
Operational	O	1/5 Sec/RTO	1/5 Sec/RTO	Slew Limits set to closely together, Slew Left Cut and Slew Right Cut disabled.

DISCLAIMER

Incorrect installation of any part and or incomplete calibration will affect the correct operation of the Series 1-S.

If in doubt contact GKD Technologies.

GKD Technologies reserve the right to change these instructions in line with the policy of continuous improvement.

