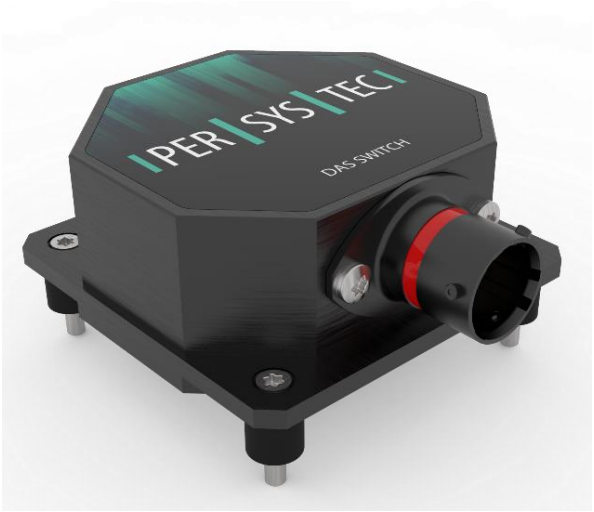
DUAL-ANALOGUE SIGNAL SWITCH DAS-SWITCH



DAS-SWITCH is a miniature device designed for use under harsh motorsport environment. The use of lightweight anodized aluminium allows the total mass to be as low as 105grams. The function of the DAS-SWITCH is to switch between 2 Analogue Sensors of the same purpose. It contains 2 independent switches hence can be used either for 2 separate sensors or 1 dual-track sensor.

The electronic design is fully Analogue with programmable scaling coefficients protected against changes while in use. This allows not only switching between 2 independent Input signals but also scaling the signals to the same output range thus a single ECU calibration can be used regardless of the sensor selection.

An example application can be a dual-track Pedal position switching for Fly-by-wire Throttle where a “Hand-Throttle” is required for Engine fire-ups but second Pedal position sensor not supported by the ECU. The firmware is equipped with Autocalibration feature which can learn and set the scaling coefficients for each Input sensor and allow for seamless switching between the “pedal” and “hand” throttle. Another application can be for Backup Sensor strategies where under a faulty condition backup sensor needs to be selected to the same ECU input.

Monitoring and Communication of the DAS-SWITCH with the Vehicle Electronics is handled by a low-power microcontroller and can be customized to customer requirements. See the specifications below for default options.

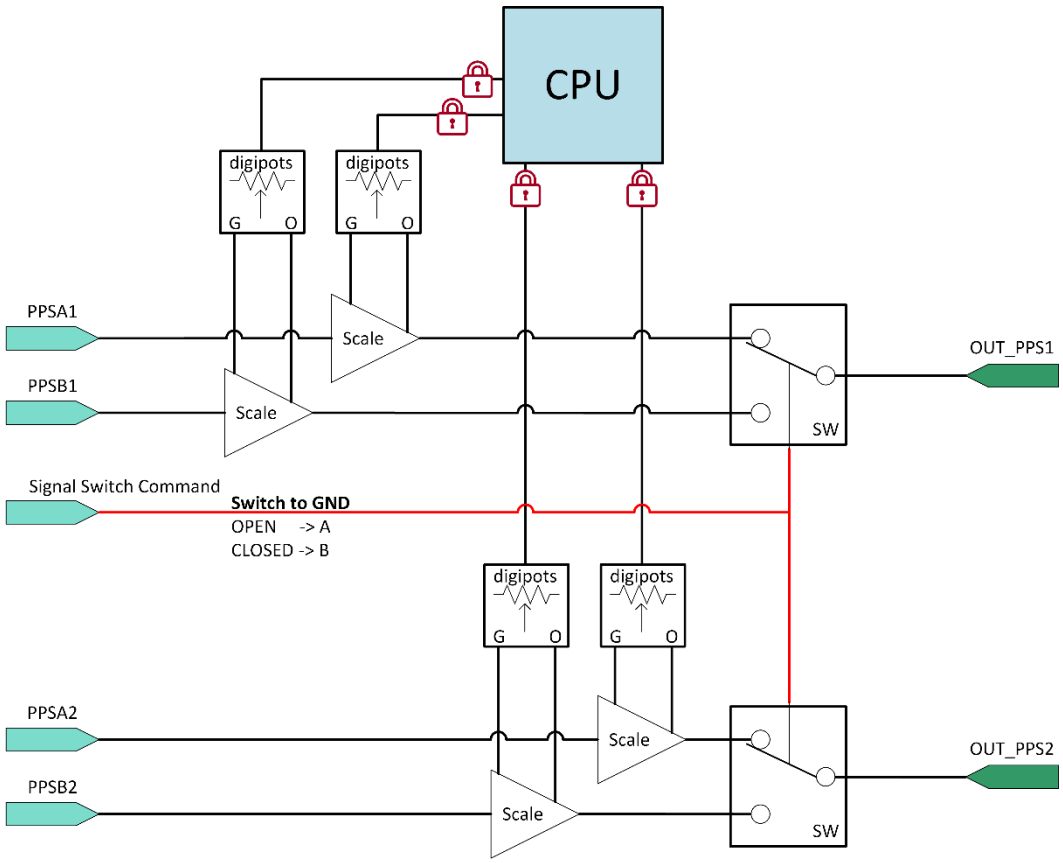
Description

Electrical	
Operating Voltage Range	+8 – 18V
Current consumption	~100mA
+5V PSU number of channels	x1
+5V PSU maximum current	100mA @5V (<0.1V voltage drop)
Input (sensor)	
Sensor type	Analogue
Number of Input channels	x4 (x2 dual)
Sensor Voltage Range	0 – 5V
Switch Input	
Switch polarity(1)	Switch to GND
Internal pull-up	3kOhm to 5V
Output	
Sensor Type	Analogue
Number of Output channels	x2 (x1 dual)
Analogue Output Voltage Range	0 – 5V
Analogue reference	ECU ground

Scaling	
Resolution (digipot)	12bit (1024)
Gain range	0.4x – 2.4x
Offset range	-5 – +5V
Communication	
CAN	CAN 2.0B
Baud rate	**1M**, 500k, 250k
Termination	Available on request
Base arbitration IDs	See CAN Communication
Mechanical	
Operating Temperature	0° - 70°C
Maximum Dimensions	73 x 62 x 27 mm
Case material	Aluminium alloy
Weight	~105 g
Environmental	
IP rating	IP65
Connection	
Connector	AS010-35PN
Mating Connector	AS610-35SN

(1) Other options available upon request

Analogue Diagram

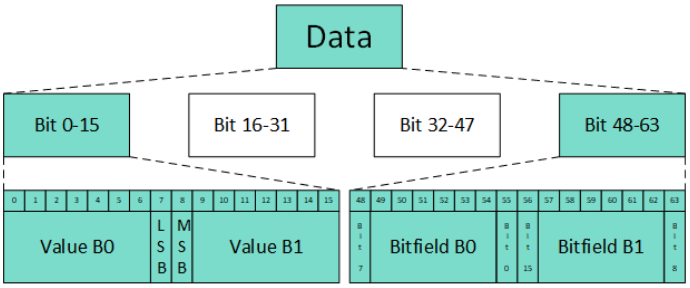


Scale Formula

$$V_{out} = Gain \times V_{in} + Offset$$

CAN Communication

All CAN Identifiers and parameters can be changed to customer requirements. The CAN description below is defined using a bit index from start of the data field in the message. All “multi-byte” channels are in **LITTLE**-ENDIAN (**Intel**) format (first byte first).



Receive

Packet	**DAS_SWRx_Cal**			
ID	0x40			
Direction	DAS Rx			
Rate	On Demand			
Bits	**Name**	**Gain**	**Offset**	**Notes**
0-15	CAL_trigger			
		Bit 0-3	-	
		Bit 4-7	CAL_trigger	(code **0xA**)
		Bit 8-15	-	
16-31	-			
32-47	-			
48-63	-			

Transmit

Packet	**DAS_SWTx1_Status**			
ID	0x41			
Direction	DAS Tx			
Rate	10Hz			
Bits	**Name**	**Gain**	**Offset**	**Notes**
0-15	V_PPS1_out	0.005	0	[V]
16-31	V_PPS1_out	0.005	0	[V]
32-39	CAL_calibrationCode			Enum
40-47	DAS_Faults			Bitfield
48-55	DAS_commandSignal			Enum
56-63	-			

Packet	**DAS_SWTx2_Voltages**			
ID	0x42			
Direction	DAS Tx			
Rate	10Hz			
Bits	**Name**	**Gain**	**Offset**	**Notes**
0-15	V_PPSA1	0.005	0	[V]
16-31	V_PPSA2	0.005	0	[V]
32-47	V_PPSB1	0.005	0	[V]
48-63	V_PPSB2	0.005	0	[V]

Packet	DAS_SWTx3_Scales			
ID	0x43			
Direction	DAS Tx			
Rate	10Hz			
Bits	**Name**	**Gain**	**Offset**	**Notes**
0-7	CAL_gainPPSA1	0.01	0	[-]
8-15	CAL_offsetPPSA1	0.04	-5.1	[V]
16-23	CAL_gainPPSA2	0.01	0	[-]
24-31	CAL_offsetPPSA2	0.04	-5.1	[V]
32-39	CAL_gainPPSB1	0.01	0	[-]
40-47	CAL_offsetPPSB1	0.04	-5.1	[V]
48-55	CAL_gainPPSB2	0.01	0	[-]
56-63	CAL_offsetPPSB2	0.04	-5.1	[V]

Packet	DAS_SWTx3_System			
ID	0x44			
Direction	DAS Tx			
Rate	1Hz			
Bits	**Name**	**Gain**	**Offset**	**Notes**
0-7	V_DAS_SensorSupply	0.025	0	[V]
8-15	I_DAS_SensorSupply	1	0	[mA]
16-23	DAS_CPUtemp	1	0	[°C]
24-31	DAS_SWversion	Bit 0-3	Major SW ver.	
		Bit 4-7	Minor SW ver.	
32-39	DAS_SerialNumber	1	0	[-]
40-48	-			
48-63	-			

CAL_calibrationCode

Code (hex)	Description
0x0	CODE_AWAITING
0x1	CODE_START
0x2	CODE_PUMP_PPSA
0x3	CODE_STORE_PPSA
0x4	CODE_PUMP_PPSB
0x5	CODE_STORE_PPSB
0x6	CODE_SUCCESS
0x7	CODE_FAIL

DAS_Faults

Bit	Description
0	ERR_MemoryAll
1	ERR_MemoryGain
2	ERR_MemoryOffset
3	ERR_CurveDir
4	ERR_PSUamps
5	ERR_PSUvolts

DAS_commandSignal

Code (hex)	Description
0x0	PPSB_selected
0x1	PPSA_selected

Coefficient Autocalibration

For correct functionality is necessary to perform this Autocalibration procedure. It is designed to find and set Analogue circuit coefficients for the Output Voltage to be within the desired ranges for the given Inputs. See Analogue schematics for more details.

After successful Autocalibration the settings are stored inside the NV (non-volatile) memory of the Analogue circuit itself thus the settings are remembered over powercycle.

Perform this Autocalibration when Input sensors ranges change or when necessary.

Trigger

- Trigger over CAN
- Packet: DAS_SWRx_Cal (0x40)
- Channel: CAL_trigger (4bits)
- Content:

  Autocalibration is triggered on rising edge from **0** to **0xA** (10 dec)

Procedure

CODE_AWAITING after power up the unit.

1. CAL_trigger signal sent
2. **CODE_START**

   The system is getting ready for PPSA sensor calibration
   Keep the PPSA Sensor in closed position during this phase
   After 5seconds it goes to next state
3. **CODE_PUMP_PPSA**

   Pump PPSA Sensor for the system to learn the limits (min & max)
   After 10seconds it goes to the next step
4. **CODE_STORE_PPSA**

   The system is getting ready for PPSB sensor calibration
   Keep the PPSB Sensor in closed position during this phase
   After 5seconds it goes to next state
5. **CODE_PUMP_PPSB**

   Pump PPSA Sensor for the system to learn the limits (min & max)
   After 10seconds it goes to the next step
6. **CODE_STORE_PPSB**

   The system calculates and sets the Analogue circuit coefficients
   After it is finished it goes to the next step
7. **CODE_SUCCESS** or **CODE_FAIL**

   The result of the Autocalibration process
   CODE_FAIL reason in DAS_Faults bitfield

Curve direction

Only the following combination of Input sensor curve directions are allowed for Autocalibration:

A	//	X	\\	//	X	\\	X
B	//	X	\\	X	//	X	\\
	✓	✓	✓	✗	✗	✗	✗

Pinout

Connection	
Connector	AS010-35PN
Mating Connector	AS610-35SN

Pin	Function
1	BATT +
2	BATT GND
3	CAN Hi
4	CAN Lo
5	+5V PSU
6	Sensor GND
7	PPSA1
8	PPSA1
9	PPSB1
10	PPSB2
11	Signal Switch Command
12	OUT_PPS1
13	OUT_PPS2

Drawing