

AP-20D

Compact Pressure Transmitter With I²C Digital Output

- Pressure range : 0 to 600mmH₂O
- Piezo-resistive silicon micro-machined sensor
- Gauge type pressure sensor
- I²C interface
- Temperature Compensation : 0 ~ 50°C
- Operating voltage 5.0V
- RoHS compliant and Halogen-free

The AP-20D is the pressure sensor which measures gauge pressures. It consists of a silicon micro-machined sensing element chip and a signal conditioning ASIC. The pressure sensor element and the ASIC are mounted inside a system-in-package and wire-bonded to appropriate contacts. The AP-20D provides the digital output data with the format of I²C interface. It can achieve ESD robustness, fast response time, high accuracy and linearity as well as long-term stability. All measurement data is fully calibrated and temperature compensated. In addition, it allows for easy system integration. Pressure transmitter has a variable semiconductor sensing element with a programmable ASIC and a hybrid circuit for reliable signal conditioning and maximum electronic integration.

□ ASIC Specification [VDD = 5.0V]



TYPICAL APPLICATIONS

- ✓ Transmissions
- ✓ Compressors & Pumps
- ✓ Water Management
- ✓ Environment control systems

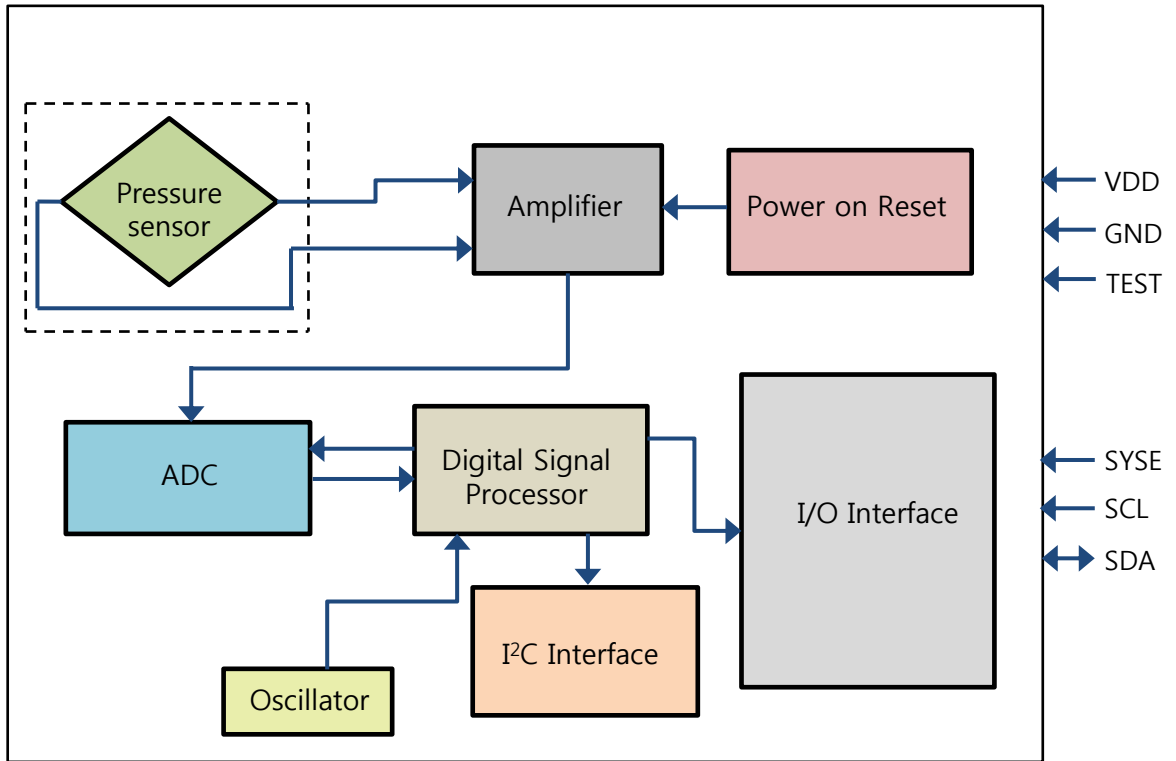
Parameter	Test Conditions		MIN	TYP	MAX	UNIT	Symbol
	VDD	Conditions					
Operating Voltage	-	-	4.5	5.0	5.5	V	V _{DD}
Operating Current	5.0V	-	-	1.7	2.0	mA	I _{DD}
Standby Current	5.0V	System standby	-	0.1	1	μA	I _{STB1}
Compensation Temp.	-	-	0	-	+50	°C	T _{CMP}
Storage Temp.	-	-	-40	-	+125	°C	T _{ST}
Resolution	-	-	-	0.30	-	mmH ₂ O	R
Human Body Mode	5.0V	MIL-STD-883E Method 3015.7	-	2	-	kV	ESD
Pressure Accuracy (Temp error)	5.0V	T : 0°C ~ 50°C P : 0 ~ 600mmH ₂ O	-5.0	-	+5.0	mmH ₂ O	P _{ACC}
Load Resistance	-	T _A = 25°C	9	-	10	kΩ	R _L
Humidity	-	T _A = 25°C	-	-	95	%RH	R _H
Over pressure	-	T _A = 25°C, Both Ports	1,300	-	1,800	mmH ₂ O	P _O
Burst pressure	-	T _A = 25°C, Port 1	2,000	-	3,000	mmH ₂ O	P _B
Solder Temp.	-	T _A = 250°C	3	-	5	Sec.	T _S

□ Operating Conditions

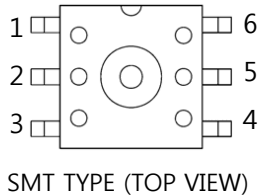
Operating Conditions						
Parameter	MIN	TYP	MAX	UNIT	Symbol	
Positive Supply Voltage for IC Operation	4.5	-	5.5	V	V _{DD}	
Bridge Resistance (ideal)	2.7	3.3	3.9	KΩ	R _{BRG}	
Ambient Temperature Range, Operating Range	-30	-	85	°C	T _{amb}	
External Capacitance between VDD and Ground (VSS)	0.47	10	20	μF	C _{VDD}	
Pull-Up Resistance on SDA	1.0	10	-	KΩ	R _{PU}	

□ Main ASIC Part Diagram

Diagram



Pin Configuration



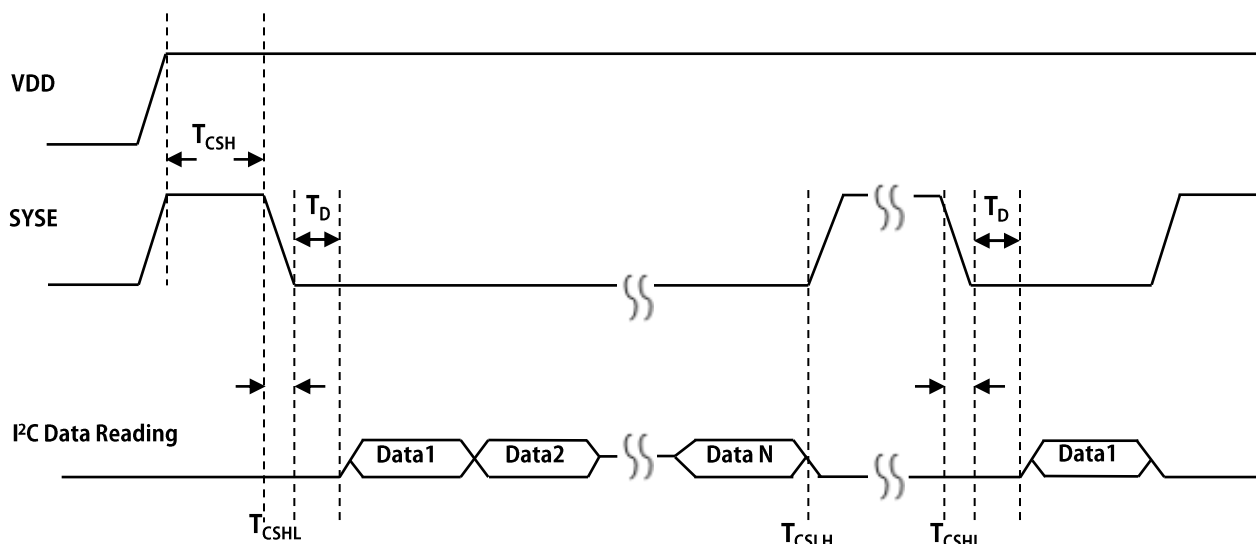
Pin Description

Pin No.	Pin Name	I/O	Function description
1	SCL	I	Serial Data Input (Open Drain Output)
2	SDA	I/O	Serial Data Input / Output (Open Drain Output)
3	VSS	-	Connected to GND
4	TEST	-	Connected to VDD
5	VDD	-	Connected to VDD
6	SYSE	I	System Enable / Disable

System Reading Timing

chart

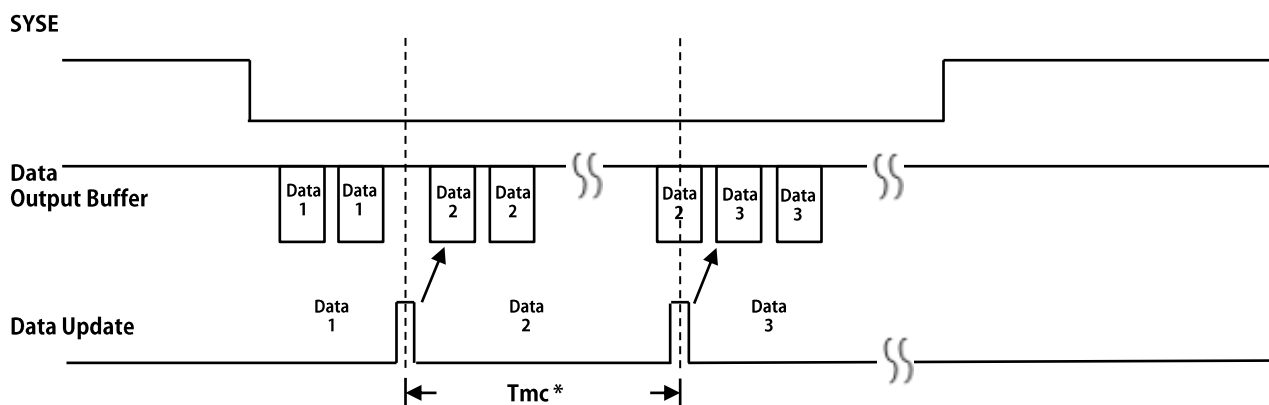
Note : T_D is required for sensor to get thermo stabilized after being activated.
Data retrieved within T_D period might be incorrect.



Data Update Timing

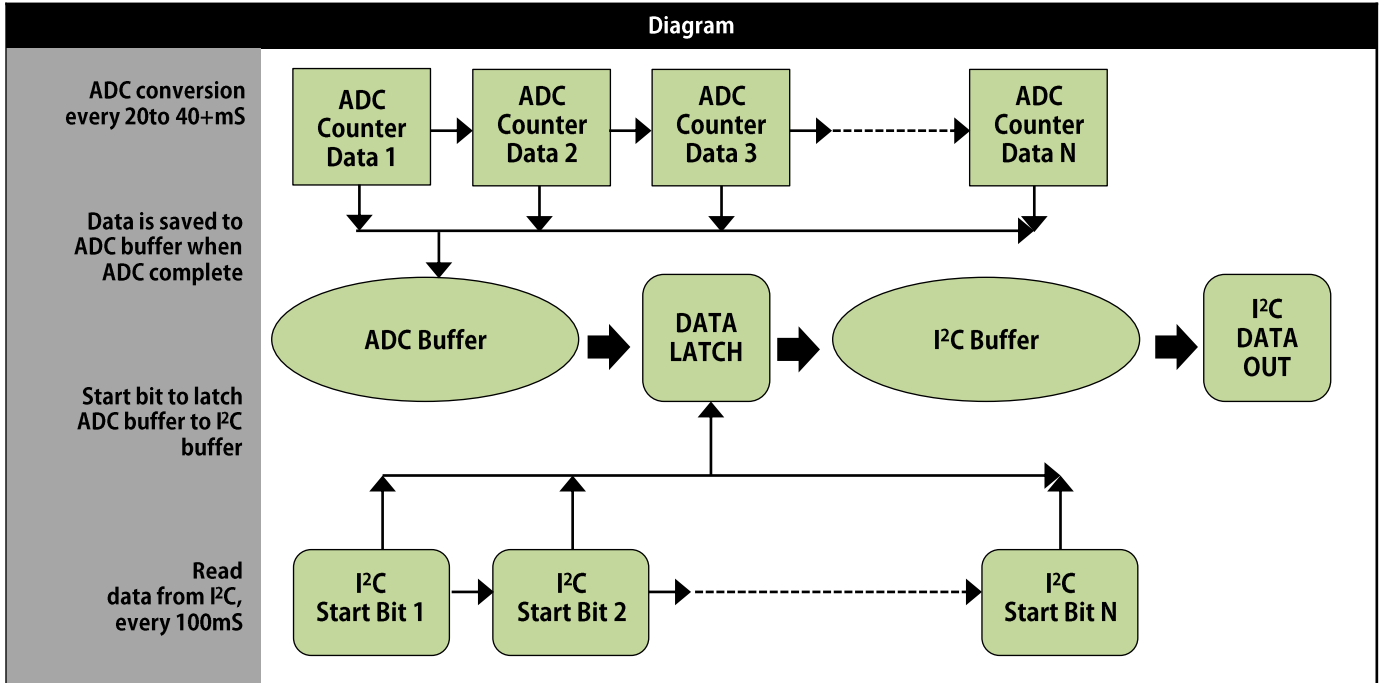
chart

Note : T_D is required for sensor to get thermo stabilized after being activated.
Data retrieved within T_D period might be incorrect.

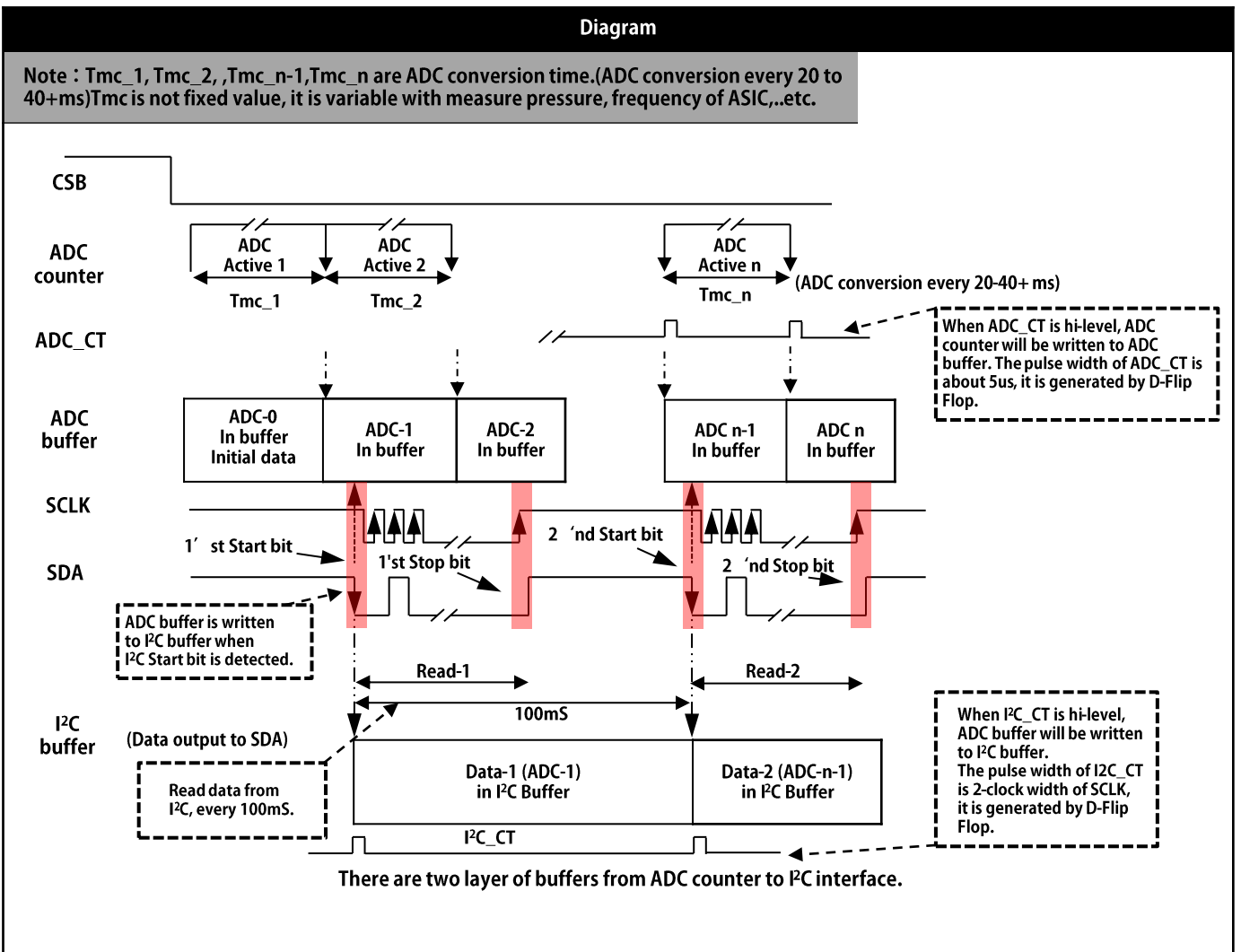


Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{CSH}	CS High Hold Time	100	-	-	μ S
T_{CSHL}	CS High To Low Time	-	-	1	mS
T_{CSLH}	CS Low To High Time	-	-	1	mS
T_D	Chip Enable Delay Time	400	-	-	mS
T_{mc}^*	Data Update Time	20	-	40	mS

ADC Buffer and I²C Buffer Data Transfer Logic and sequence illustration



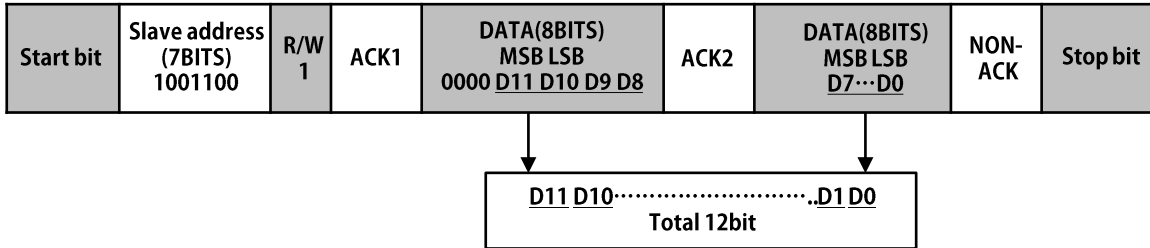
The data load Timing of Pressure ASIC



□ ASIC I²C Interface

Chart

The data transfer format of I2C (ADC with 12 bits resolution) Master read (Master—Receiver; Slave—Transmitter)



Each sensor is referenced on the bus by a 7 bit slave address. The slave address is 1001100. The eighth bit of control address is read or written which assigned by processor.

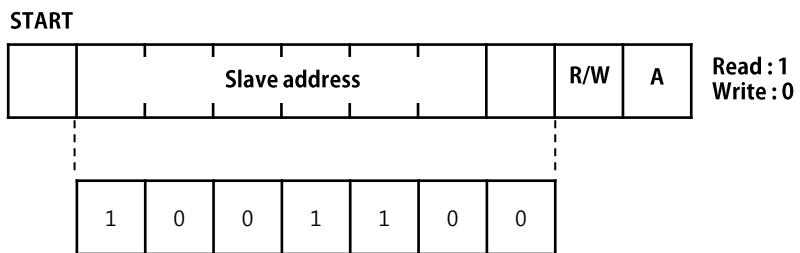


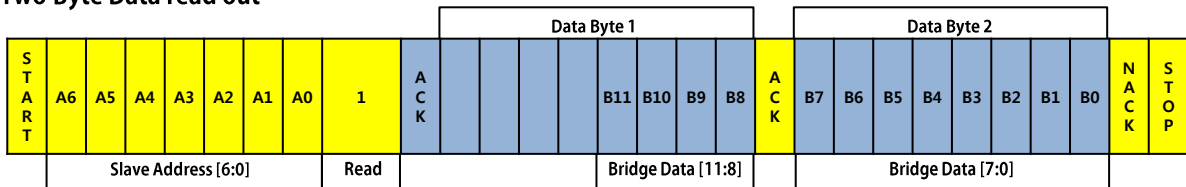
Figure 1. Control address byte

□ I²C Pressure Measurement Packets

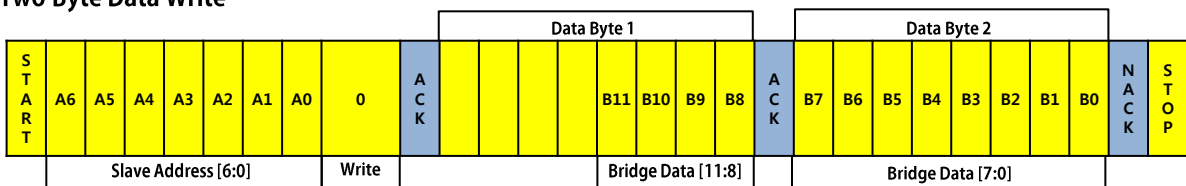
Chart

- ❖ ACK1 : That should respond a ACK1 (Low) signal to the microcontroller.
- ❖ ACK2 : The microcontroller should respond a ACK2 (Low) signal to the sensor.
- ❖ NON ACK : The microcontroller should respond a NON-ACK (High) signal the sensor.
- ❖ I²C Reading Code Example : If needed, you can refer to example in this document.

Two Byte Data read out



Two Byte Data Write



From master to slave (Yellow box) From slave to master (Blue box)

□ Bus protocol

chart

- ❖ Data transfer may be initiated only when the bus is not busy.
- ❖ During data transfer, the data line must keep stable whenever the clock is HIGH level. Changes in the data line while the clock line is HIGH will be interpreted as a start or stop condition.
- ❖ Following bus conditions has been defined as Figure 2.

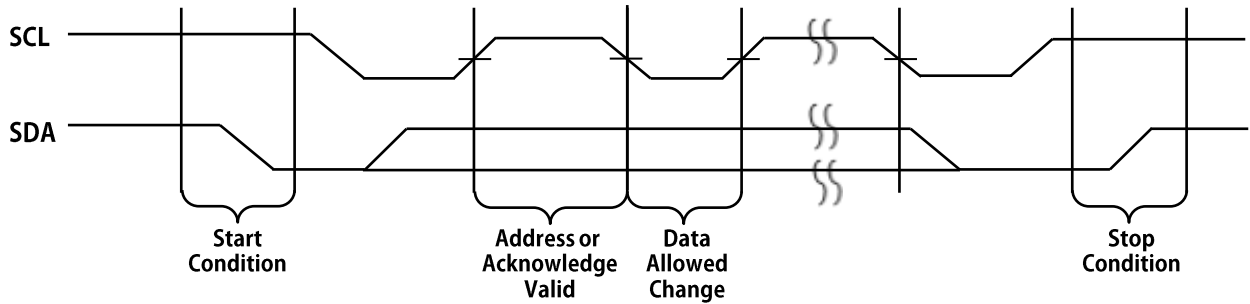
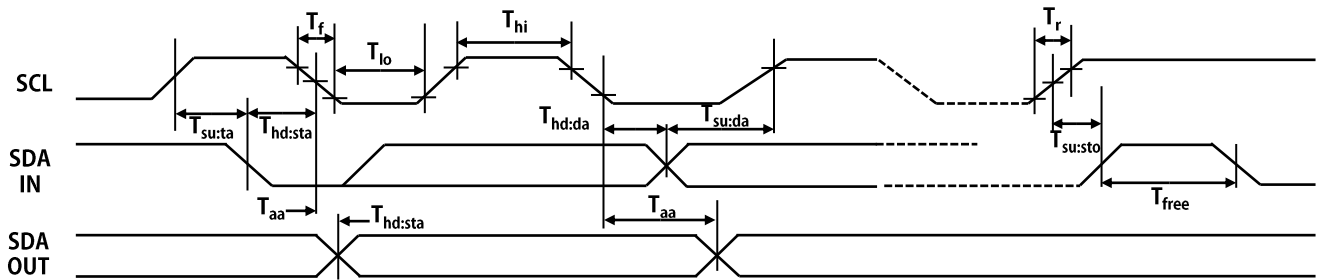


Figure 2. Data transfer sequence on serial bus

□ The data bus timing

chart



When the bus is free, both lines are pulled up to +ADD. Data on the I²C-bus can be transferred at a rate up to 100 kbit/s in the standard-mode, or up to 400 kbit/s in the fast-mode.

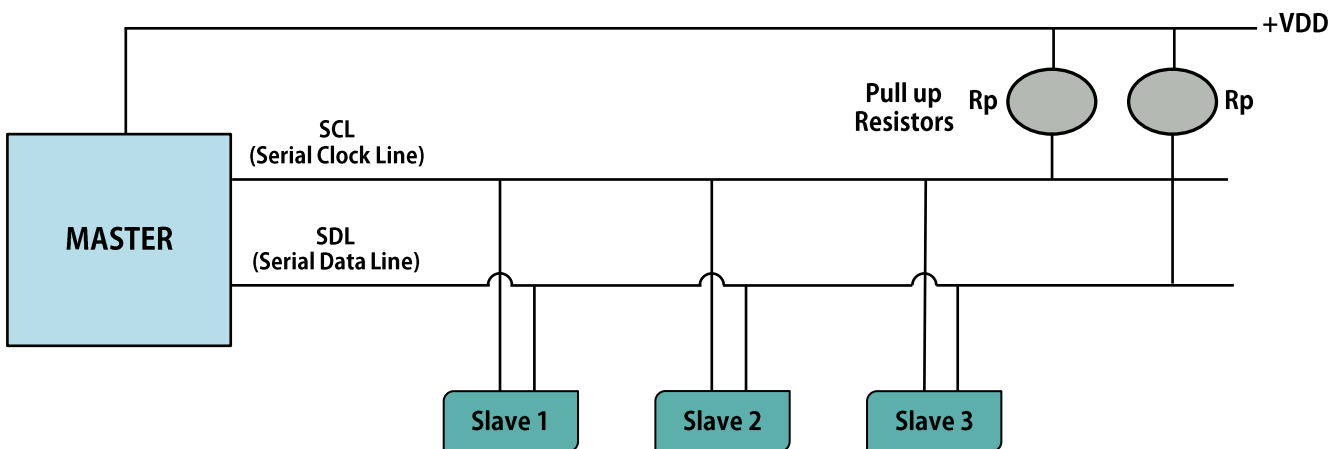


Figure 3. I²C Bus Configuration

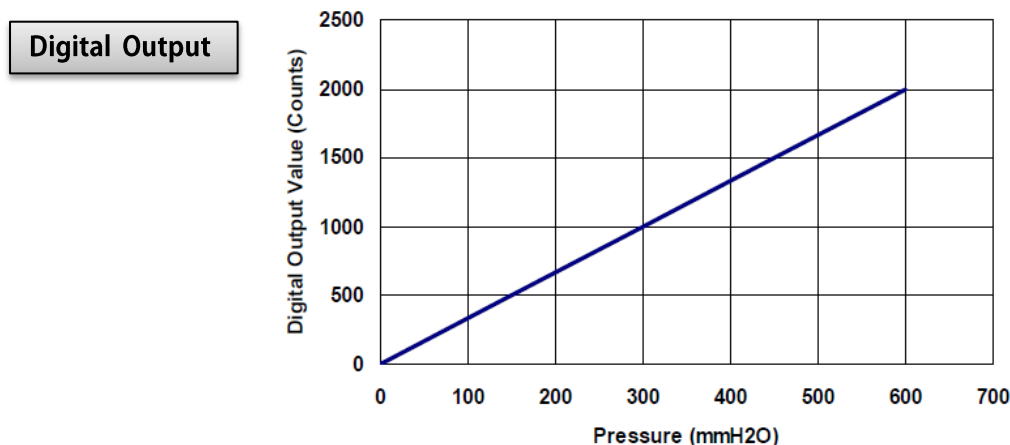
□ A.C. Characteristic

Symbol	Parameter	Standard mode		Fast mode			Unit
		MIN	MAX	MIN	Typical	MAX	
F_{scl}	Clock frequency	-	100k	-	400k	2M	Hz
T_{hi}	Clock high time	4,000	-	600	-	-	nS
T_{lo}	Clock low time	4,700	-	1,300	-	-	nS
T_r	SCL and SDA rise time	-	1,000	-	300	-	nS
T_f	SCL and SDA fall time	-	300	-	300	-	nS
$T_{hd:sta}$	START condition hold time	4,000	-	600	-	-	nS
$T_{su:sta}$	START condition setup time	4,700	-	600	-	-	nS
$T_{hd:da}$	DATA input hold time	0	-	-	0	-	nS
$T_{su:da}$	DATA input setup time	250	-	100	-	-	nS
$T_{su:sto}$	STOP condition setup time	4,000	-	600	-	-	nS
T_{aa}	Output valid from clock	-	3,500	-	900	-	nS
T_{free}	Bus free time	4,700	-	1,300	-	-	nS

□ Pressure versus Digital output value (Typical)

chart

The relationship between digital output value and pressure is given as show below

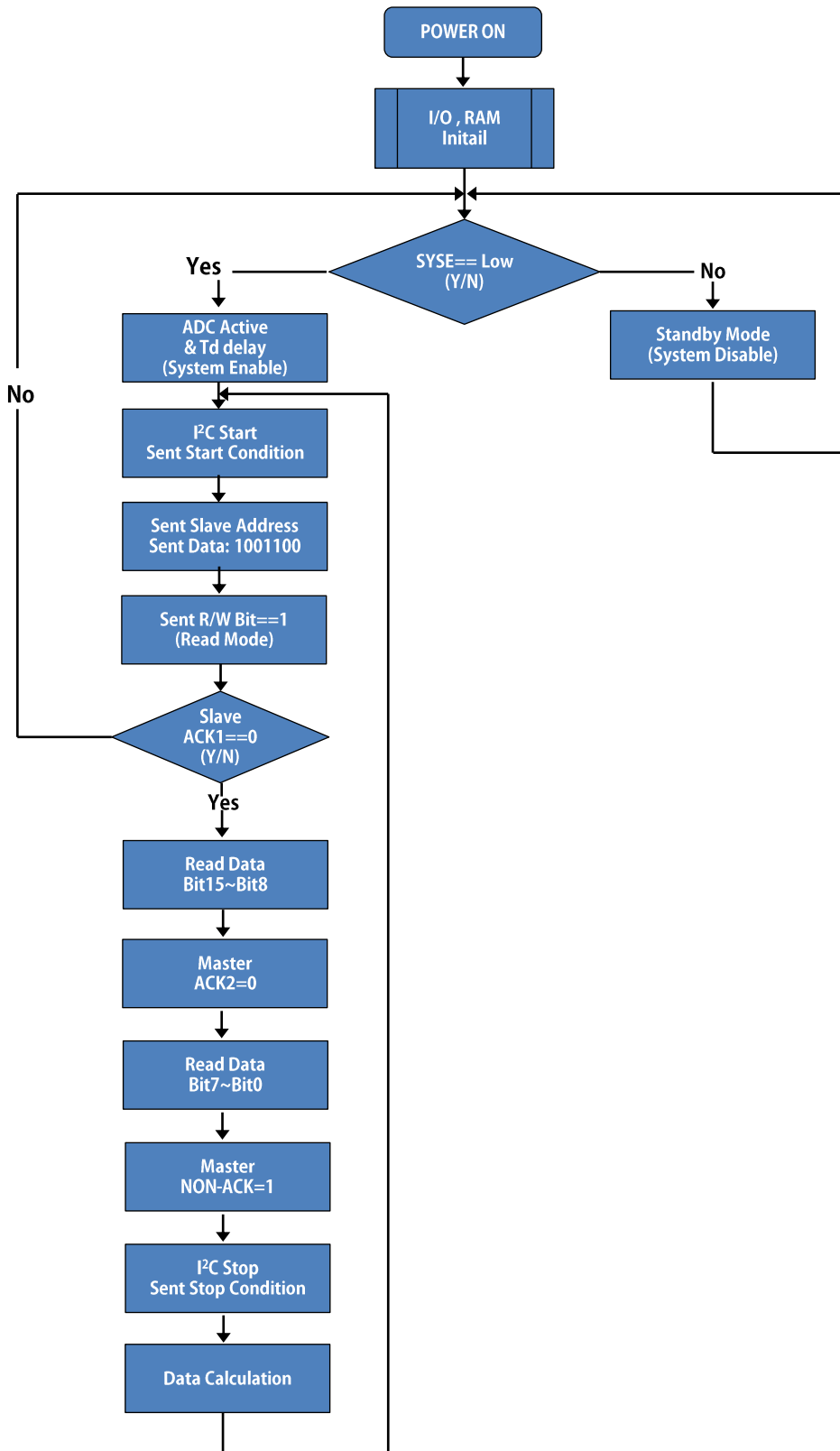


Pressure (mmH₂O)

$$\text{Pressure (mmH}_2\text{O)} = \text{Output Value} \times 0.3$$

□ Reading Flow (I²C Interface)

Chart



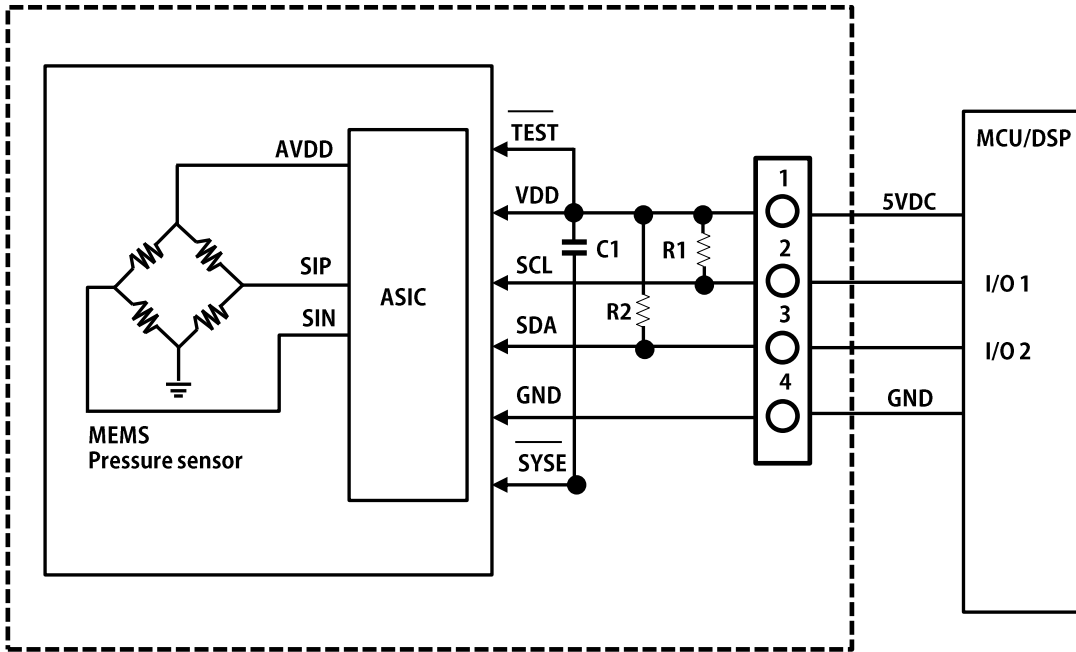
Bit No.	Description	Note
Bit 15	ADC Data Bit	Normal = 0
Bit 14	ADC Data Bit	Normal = 0
Bit 13	ADC Data Bit	Normal = 0
Bit 12	ADC Data Bit	Normal = 0
Bit 11	ADC Data Bit	
Bit 10	ADC Data Bit	
Bit 9	ADC Data Bit	
Bit 8	ADC Data Bit	
Bit 7	ADC Data Bit	
Bit 6	ADC Data Bit	
Bit 5	ADC Data Bit	
Bit 4	ADC Data Bit	
Bit 3	ADC Data Bit	
Bit 2	ADC Data Bit	
Bit 1	ADC Data Bit	
Bit 0	ADC Data Bit	

Notice:

- ❖ ACK1: Should respond a ACK1 (Low) signal to the microcontroller.
- ❖ ACK2: The microcontroller should respond a ACK2 (Low) signal to the sensor.
- ❖ NON ACK: The microcontroller should respond a NON-ACK (High) signal to the sensor.

Application Circuit

Circuit

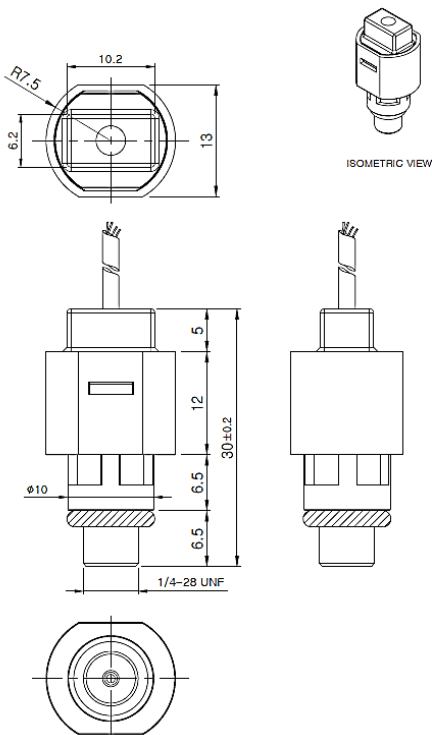


Notice:

- ❖ R1,R2 : Pull-up Resistor (1K Ω ~10K Ω)
- ❖ C1,C2 : 4.uF

SENSOR Dimensions(mm)

Dimensions(mm)



PIN No.	Description	Wire Color
<1>	SCL	GREEN
<2>	SDA	WHITE
<3>	VDD	RED
<4>	GND	BLACK

How to order

AP-20D		<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
1) Output signal	I					
I ² C	D					
2) Kind of pressure						
Absolute pressure	----- A					
Gauge pressure	----- G					
3) Pressure range						
0 to 600 mmH ₂ O	----- 600					
Other on request	----- Z					
4) Supply Voltage						
5.0 VDC	----- 5					
5) Process connection						
UNF1/4"	----- U14					
Other on request	----- Z					
6) Seal material						
Silicone	----- S					
NBR	----- N					
Viton	----- V					
Ethylene	----- E					
Neoprene	----- P					
Other on request	----- Z					
7) Cable Length						
1,000mm	----- 1000					
Other on request	----- Z					