MEMS Pressure Sensor Preliminary Datasheet

1. General Introduction

M0111 is a perfect silicon pressure sensor offering a radiometric analog interface for reading pressure over the specified full scale pressure span. M0111 incorporates a silicon piezoresistive pressure sensor die and an interior Application Specific Integrated Circuit(ASIC) in a SOP package The M0111 is fully calibrated and temperature compensated for specified span, so pressure sensor satisfy the perfect accuracy, which is utilizing a microcontroller or microprocessor with A/D inputs. Pressure sensor is for high volume application at an affordable cost and perfect performance. Customized calibration parameter (pressure range, working voltage, output etc.) are available.

2. Features

- Calibrated Digital Signal (I2C Interface)
- Optional 1.8V～5.5V Power Supply
- Temp. Compensated: 0℃～+60℃ (32℉～+140℉)
- MEMS process technology digital pressure sensor (24 bit ΣADC)
- Operation range: -1 bar ~ 10 bar
- Gauge type sensor with ASIC

3. Applications

- Blood pressure measurement
- Industrial control
- Pressure gauge

4. Specifications

4.1 Pressure and Temperature Characteristics

Table1: Pressure Output Characteristics @ VDD = 5.0V, T = 25°C unless otherwise noted

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Pressure Measurement Range	P_{FS}	LD(Digital low pressure operation)	-100		100	kpa
		HD(Digital high pressure operation)	-100		1000	
Pressure AbsoluteAccuracy		Full scale from -0℃ to 60℃	-1.5		+1.5	%
Pressure RelativeAccuracy		Full scale from 25℃ to 60℃		±1		%
Max Error with Power Supply		Power supply from 1.8V to 5.5V	-0.25		+0.25	%
Pressure Resolution		Pressure Mode		0.02		%
Board Mount Drift		After solder reflow		0.05		%
Long Term Drift		After a period of 1 year		±0.6		%
Reflow soldering impact		IPC/JEDEC J-STD-020C		0.05		%

Table2: Temperature Output Characteristics @ VDD = 5.0V, T = 25°C unless otherwise noted

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Operation Temperature Range	T_{OP}		0	25	60	℃
Temperature Absolute Accuracy		25℃		±1.5		℃
Temperature Absolute Accuracy		-10℃ to +60℃		±2.5		℃
Max Error with Power		Power supply from 1.8V to 3.6V			±0.5	℃
Temperature Resolution of Output Data				0.01		℃

4.2 Electrical Characteristics

Table3: DC Characteristics @VDD=5.0 V, T=25℃ unless otherwise noted

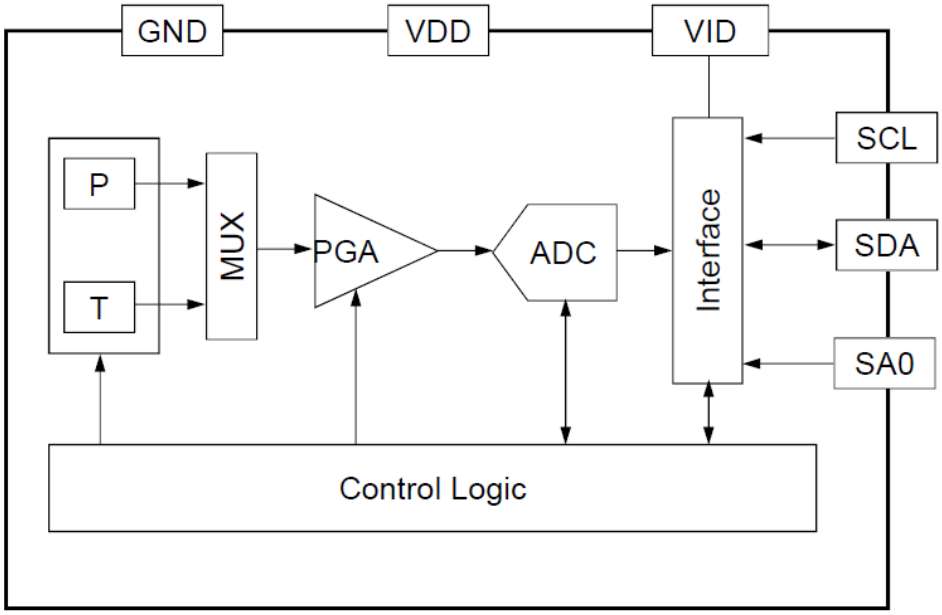
Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Operation Supply Voltage	V_{DD}		1.8	3.0	5.5	V
Operation Temperature	T_{OP}		-40		85	℃
Supply Current@25°C on during conversion	IBDD_pgaoff	PGA off(Gain<=2)		0.9		mA
	IBDD_pgaon	PGA on (Gain>=4)		1.5		mA
Conversion time(*1)	Tc	OSR 32768 16384 4096 1024 256		6.34 3.78 2.5 1.86 1.54		ms
Supply current (*2) (1 sample per sec.)	Idd	OSR 32768 (default) 16384 4096 1024 256		800 420 190 120 97		uA
Standby Supply Current	I_{DDSTB}	At 25℃			1	μA
Serial Data Clock Frequency	f_{SCLK}	I^2C protocol, pull-up resistor of 10k		100	400	kHz
Digital Input High Voltage	V_{IH}		0.8			V
Digital Input Low Voltage	V_{IL}				0.2	V
Digital Output High Voltage	V_{OH}	IO = 0.5 mA	0.9			V
Digital Output Low Voltage	V_{OL}	IO = 0.5 mA			0.1	V
Input Capacitance	C_{IN}			4.7		pF

(*1): The Pressure default factory OSR is 1024
(*2): The temperature default factory OSR is 1024

5. Absolute Maximum Rating

Parameter	Symbol	Conditions	Min	Typ.	Max	Unit
Overpressure	P_{MA}				30	bar
Supply Voltage	V_{DD}		-0.3		6.5	V
Interface Voltage	V_{IF}		-0.3		VDD+0.3	V
Storage Temperature Range	T_{STG}		-40		125	℃
Maximum Soldering Temperature	T_{MS}	40 second maximum			250	℃
ESD Rating		Human body mode	-2		+2	kV
Latch-up Current		At 85℃	-100		100	mA

6. Schematic Diagram & Pin Out



7. Function Descriptions

7.1 General Description

The M0111 is pressure sensor that measures the pressure and the temperature by an internal 24- bit ADC and compensates them by a patented algorithm. The fully-compensated values can be read out via the I²C interface by external MCU. The uncompensated values can also be read out in case the user wants to perform their own data compensation. Furthermore, the device allows the user to setup the temperature, pressure threshold values for various events. Once the device detects that a certain event has happened, a corresponding interrupt will be generated and sent to the external MCU. Also, multiple useful interrupt options are available to be used by the user.

7.2 Factory Calibration

Every device is individually factory calibrated for sensitivity and offset for both of the temperature and pressure measurements. The trim values are stored in the on-chip 128-Byte Non-Volatile Memory (NVM). In normal situation, further calibrations are not necessary to be done by the user.

7.3 Automatic power on initialization

Once the device detects a valid VDD is externally supplied, an internal Power-On-Reset (POR) is generated and the device will automatically enter the power-up initialization sequence. After that the device will enter the sleep state. Normally the entire power-up sequence consumes about 400 us.

7.4 Sensor Output Conversion

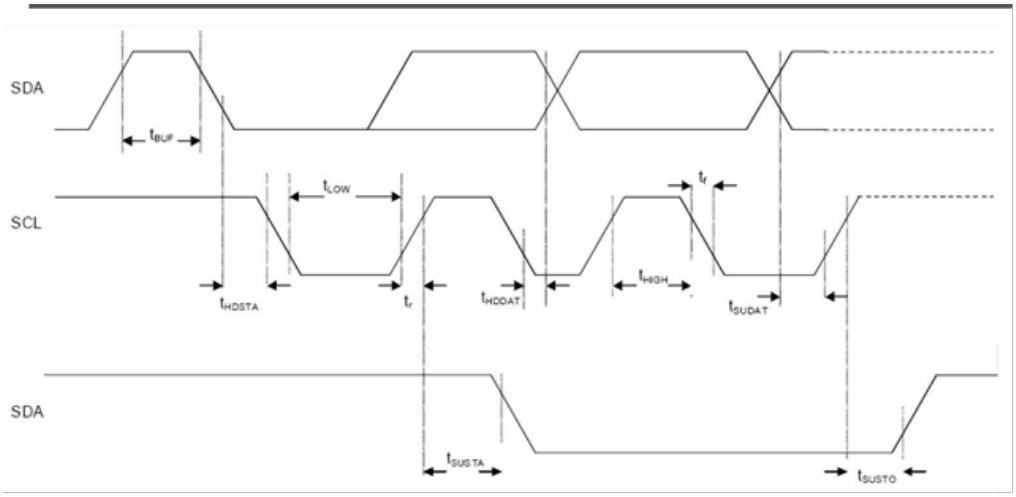
For each pressure measurement, the temperature is always being measured prior to pressure measurement automatically, while the temperature measurement can be done individually. The conversion results are stored into the embedded memories that retain their contents when the device is in the sleep state.

8. High-Speed I²C Digital Output Interface

The I²C interface is fully compatible to the official I²C protocol specification. All the data are sent starting from the MSB. Successful communication between the host and the device via the I²C bus can be done using the four types of protocol introduced below.

I²C slave Timing Values :

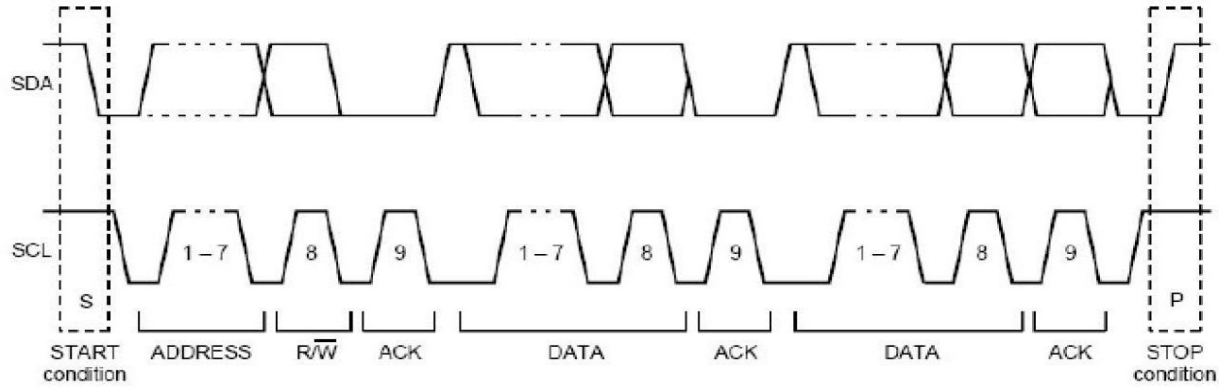
Parameter	Symbol	Conditions	I²C			Unit
			Min	Typ.	Max	
Clock frequency	fBsclB				400	kHz
SCL low pulse	tBLOWB		1.3			us
SCL high pulse	tBHIGHB		0.6			us
SDA setup time	tBSUDATB		0.1			us
SDA hold time	tBHDDATB		0.0			us
Setup Time for a repeated start condition	tBSUSTAB		0.6			us
Hold time for a start condition	tBHDSTAB		0.6			us
Setup Time for a stop condition	tBSUSTOB		0.6			us
Time before a new transmission can start	tBBUFB		1.3			us



I2C Timing Diagram

The I2C interface protocol has special bus signal conditions. Start (S), stop (P) and binary data conditions are shown below.At start condition, SCL is high and SDA has a falling edge. Then the slave address is sent. After the 7 address bits, the direction control bit R/W selects the read or write operation. When a slave device recognizes that it is being addressed, it should acknowledge by pulling SDA low in the ninth SCL (ACK) cycle.

At stop condition, SCL is also high, but SDA has a rising edge. Data must be held stable at SDA when SCL is high. Data can change value at SDA only when SCL is low.



I2C Protocol

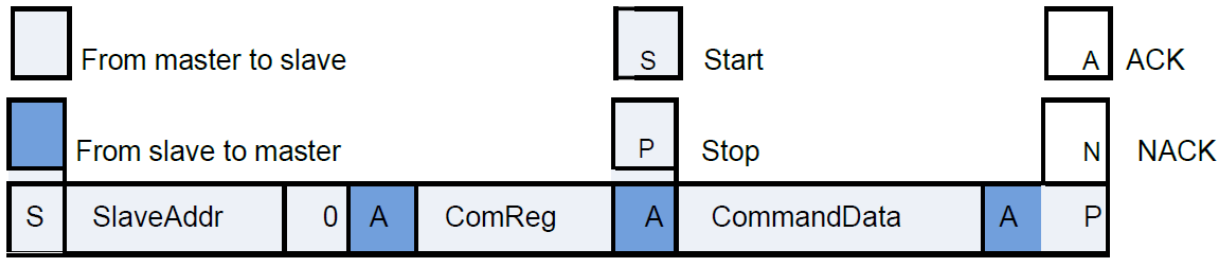
9. I²C Device Address

The I²C device address is shown below. The LSB of the device address is corresponding to address 0XDA (write) and 0XDB (read)

A7	A6	A5	A4	A3	A2	A1	W/R
1	1	0	1	1	0	SDO/ADDR	0/1

10. I²C Protocol

10.1 Send Command



ComReg=0x30 CommandData:

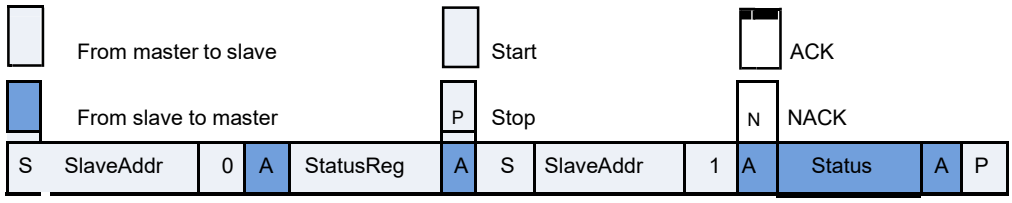
Address	Description	R/W	Bit7	Bit6	Bit5	Bit4	Bit3	Bit2	Bit1	Bit0
0x30	CMD	RW	Sleep_time<3:0>				Sco	Measurement_ctrl<2:0>		

Sleep time<3:0>: 0000:0ms, 0001:62.5ms,0010:125ms... 1111: 1s, only active during sleep mode conversion.

Measurement control<1:0>: 000b, indicate a single shot temperature signal conversion. 001b, indicate a single shot sensor signalconversion.010b: indicate a combined conversion (once temperature conversion immediately followed by once sensor signal conversion).011b: indicate a sleep mode conversion (periodically perform once combined conversion with an interval time of „sleep time").

Sco: 1, Start of conversion, automatically come back to 0 after conversion ends (except sleep mode conversion).

10.2 Read Status



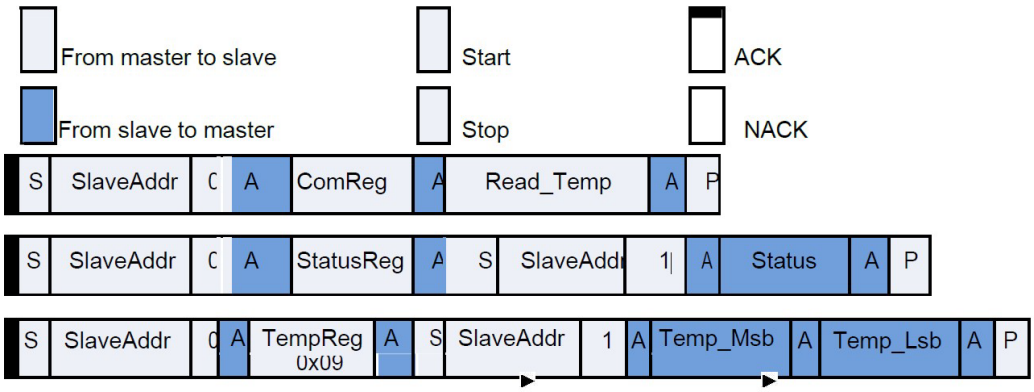
StatusReg

=0x02

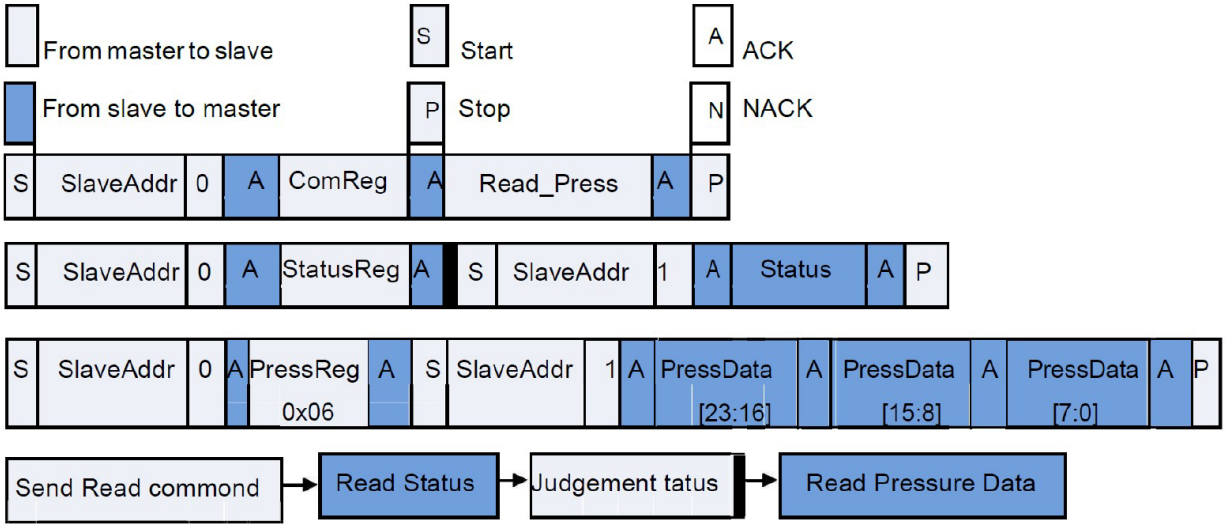
Status:

DRDY：1, indicates once conversion complete, and the output data is ready for reading.

10.3 Read the Temperature Values



10.4 Read the Pressure Values



10.5 Calculate the pressure data and the temperature data

Pressure data = Pressure

Data [23:0] /

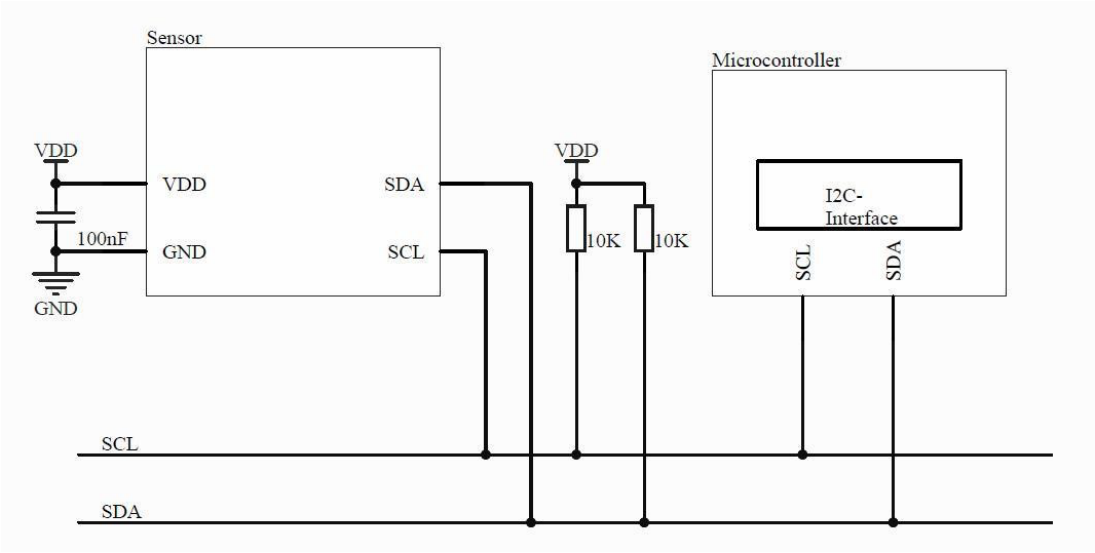
64(LD=64,HD=8);

Temperature data :

Temp_Msb integer part, bit7 is the sign bit,0 for positive, and 1 for negative,

bit6~bit0 equals to °C Temp_Lsb Decimal part equals to (1/256) °C

11. Typical Application Circuit for I2C mode



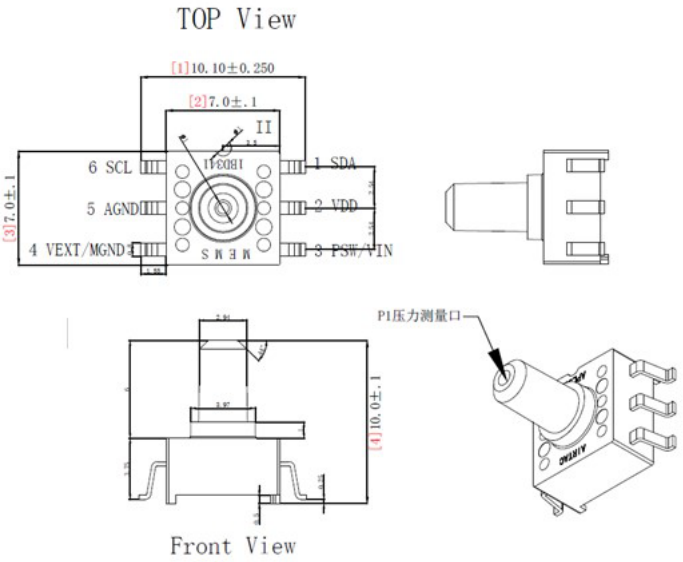
12. Ordering Information

Ordering Code
1000kPa = M0111HD
100kPa = M0111LD

Date Code Naming Rule
Example : 38A
A=2021 B=2022 C=2023…
38 weeks = 38

13. Pin Layout and Definition

Unit : mm



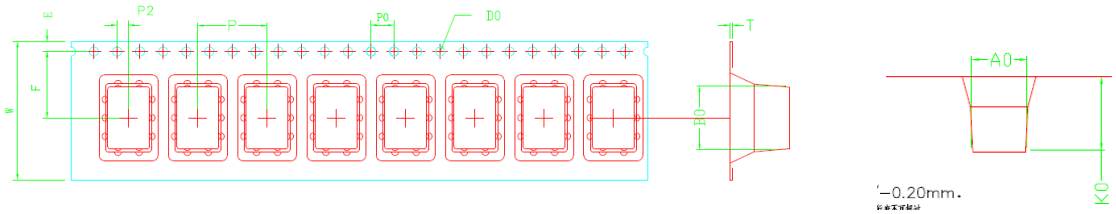
Pin#	Name	Description
1	SDA	IIC data pin
2	VDD	Core circuit power supply in
3	PSW/VIN	Engineering testing 1, no need to lead out
4	VEXT/MGND	Engineering testing 2, no need to lead out
5	AGND	Ground pin
6	SCL	IIC Clock pin

14. Packing Instructions

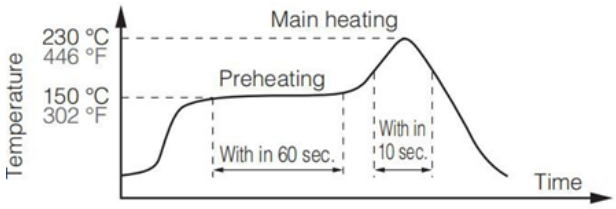
- 500pcs per 13” reel & dry packing
- Vibration-proof packing

ITEM	W	A0	B0	K0	R1	P	F	E	D0	D1	P0	P2	T	13"	
DIM	24.00	7.35	10.80	10.40	~	12.00	11.50	1.75	1.50	~	4.00	2.00	0.50	length/reel	pcs/reel
TOLE	+0.30	+0.15	+0.15	+0.10		+0.10	+0.10	+0.10	+0.10		+0.10	+0.15	+0.05	6.5M	500 pcs
	-0.30	-0.15	-0.15	-0.10		-0.10	-0.10	-0.10	-0.10		-0.10	-0.15	-0.05		

Unit : mm



15. Reflow Profile Chart



Copy Rights and Disclaimer

1. This document may not be reproduced or duplicated, in any form, in whole or in part without prior written consent of MIT . Copyrights © 2023, MIT-Magnetic Integrated Technology Incorporated.
2. MIT-Magnetic Integrated Technology reserves the right to make changes to the information published in this document at anytime without notice.
3. MIT’s products are limited for use in normal commercial applications. MIT’s products are not to be used in any device or system, including but not limited to medical life support equipment and system.