ATTACHMENT E.

- Operating Description -

■ Description of Transmitter(HSN-1A)

1. Introduction

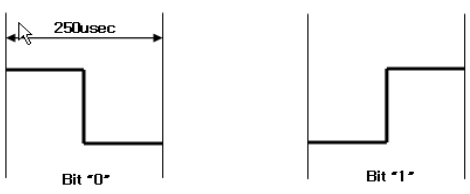
- HSN-1A is periodically measure and transfer to ECU the pressure and temperature inside of tire.
- It also monitors and transfers the condition of Battery and Sensor.
- Following is the major functionalities.
  - ► Measure and transfer the tire pressure
  - ► Measure and transfer inside temperature of tire.
  - ► Measure and transfer tire rotating condition by acceleration value.
  - ► Measure and transfer voltage of mounted battery
  - ► Measure and transfer abnormal condition of sensor (pressure and accelerometer)
  - ► Decide existence and nonexistence of abnormal pressure change occurs inside of tire.

2. ELECTRICAL CHARACTERISTICS

	Transmitter
Model Name	HSN-1A
Supply Voltage	DC 3V
Operating Voltage	DC 2.2 ~ 3V
Consumption current	TBD Max 12mA
Operating Frequency	315MHz(±30kHz)
Operating temperature	-40 ~ +120℃
Modulation	FSK(Manchester Code)
Bit Rate	4 Kbps

3. DESCRIPTION MODE

1) Bit Format



2) Frame Data Format

WU transferred data is composed of total 92bits and following is the structure of the data.

► Preamble (28bits)

Composed of 0xFFFFEA9. Upper 20bit 0xFFFFE is the signal for bit check of ECU RF IC. 0xA9 is the signal for program Sync.

► ID (32bits)

Unique 32bit-identification that is assigned during production

► Pressure (8bits)

Sensor measured pressure in the tire

► Temperature (8bits)

Sensor measured temperature in the tire

► Status (8bits)

Indication of current sensor condition

► CRC 8 (8bits)

Data failure check

Preamble (0xFFFFEA9) 28bits	WU ID 32bits	Pressure 8bits	Temperature 8bits	WU Status 8bits	CRC8 8bits

7	6	5	4	4	2	1	0
Sensor Condition	Motion Detection	Battery Condition	LF Response	Current State			
0 : OK 1 : Failure	0 : Stationary 1: Rolling (Detection Level 5G)	0 : OK 1 : Low Voltage	0 : NO 1 : Response	0x00	Off State		
				0x01	Normal Stationary		
				0x02	Auto Learning State		
				0x03	Normal Rolling State		
				0x04	Alert State		
				0x05	T-Shutdown State		
				0x06	Factory State		
				0x07	Fast State		
				0x08 ~ 0xFF	Reserved		

3) Characteristics for each WU conditions

- WU operates within 8 different conditions. Each condition has own unique function to change the condition depends on tire rotation/non-rotation, LF protocol, and change in pressure.

WU State	Measurement Time				RF Transmission Interval	LF Response	
	P	T	ACC	LF		LF Command	Next State
OFF	*	*	*	4s	*	Factory_LF	Factory
						Test_LF	OFF
						Normal_LF	Normal Stationary
Normal Stationary	20s	20s	20s	4s	200s	Off_LF	OFF
						Test_LF	Normal Stationary
						Factory_LF	Fast
Normal Rolling	20s	20s	20s	4s	200s	Test_LF	Normal Rolling
						Factory_LF	Fast
Auto Learning	20s	20s	20s	4s	60s	Test_LF	Auto Learning
						Factory_LF	Fast
Alert	4s	*	*	*	4s	*	*
Shutdown	4s	*	*	*	4s	*	*
Factory	*	*	*	*	Continuance Carrier	Off_LF	OFF
Fast	20s	20s	20s	4s	20s	Normal_LF	Previous State

P(Pressure) T(Temperature) ACC(Accelation) LF(Low Frequency)

► OFF

Only monitors LF signal and make no motion. Condition for transportation after production,

► Normal Stationary

Condition of ACC < 9.5g, normally represents vehicle in stop mode

► Normal Rolling

Condition of ACC ≥ 9.5g, normally represents vehicle in motion

► Auto Learning

Condition of ACC ≥ 9.5g after WU places in NSS more than 10 minutes.

This condition is for faster auto learning of the ECU.

► Alert

Condition of when the tire pressure change about 20kPa(3psi) or tire interior temperature exceed 110℃. WU transmit message five times within four seconds period in order to send fast warning.

► Shutdown

When the measured tire interior temperature is above 120℃, WU enters into sleep condition after sending message three times within four second period in order to protect itself.

► Factory

Transmit unchanged signal due to characteristic check in production.

► Fast

Condition for fast receiving rate test and product characteristics check during production.