

Functional Description

of

Siemens Korea RF SRX module

Type: 5WY8230(for 315MHz)

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FCC Compliance statement

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.

This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: You are cautioned that any changes or modifications to the equipment not expressly approved by the party responsible for compliance could void your authority to operate the equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) This device must accept any interference received, including interference that may cause undesired operation.

1. GENERAL

This is describes the hardware RF engineering of the stand alone RF receiver (SRx) for the HYUNDAI TG project, which has the general RF Hardware and RF electrical specification for the remote control radio frequency reception

1.1. Definitions and abbreviations

SRx	: Stand- alone receiver (RX)
RKE	: Remote Keyless Entry
RF	: Radio Frequency
BCM	: Body Control Module
PASE	: Passive Access Start & Entry
IPM	: In-Panel Module
PIC	: Personal Identification Card
PDWN	: Power Down
TG, BH	; Name of Hyundai motor vehicle platform
FSK	; Frequency Shift -Keying
ASK	: Amplitude Shift- Keying
LNA	: Low Noise Amplifier
Tx	: Transmitter
Rx	: Receiver
MSEL	: Modulation Selection
RISS	: Received Signal Strength Indicator
RxD	: Receiving Data
TxD	: Transmit Data
VREF	: Voltage Reference
TP	: Test Point
EOL	: End of Line
VBAT	: Voltage Battery
TTGD	: Time To Good Data
VSWR	: Voltage Standing Wave Ratio
ECU	: Electronic Control Unit
ICT	: In- Circuit Test
OST	: Oscillation Stabilization Time

2. SYSTEM DESCRIPTION

This Standalone (SRx) receiver has to support the receipt of RF telegram from transmitted in free air way by corresponding transmitter and to transmit them to a host module (e.g. the Body Control Module and PIC module).

- **KOR-baby board** receiver 315, FSK -1K data rate based on Infineon TDA 521x , which module optimized maximum for the enhanced RF working range with LNA and data filter characterization.

All receipts of RF telegram has to be transmitted to a host module with the serial linked communication line which line of single-wired serial link must be available to communicate with bi-directional for a bit rate 2.4k bauds for BCM for a bit rate 9.6k bauds for PIC.

This SRx provide a variant 4 resistors with pull- Ground down for reading of mounted code.

The processor of the SRx was selected as 8-bit Single-chip NEC's Micro-controller with 78KO series

The main function of generic SRx is

- RF signal detection (in-band)
- Data signal demodulation.
- Manchester and Shark protocol detection
- Self-polling for the standby current consumption
- Wake up function for the host module
- 315MHz RF data reception
- Serial communication with the single –wired link com.

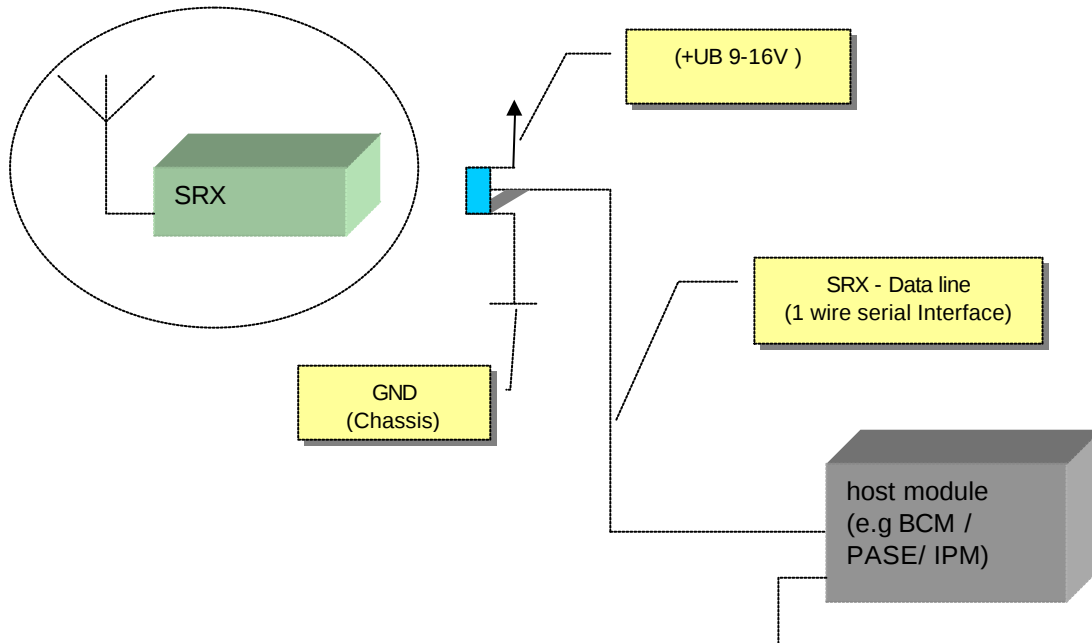
2.1. SRx system block diagram

Show the system block diagram and generic receivers.

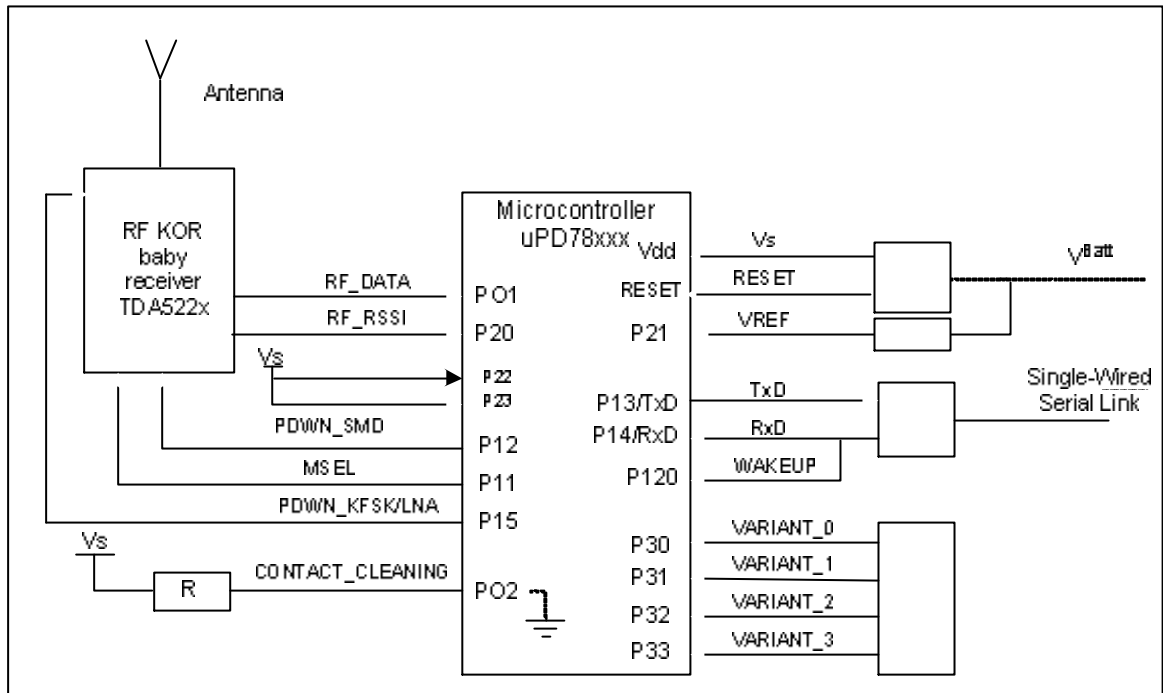
The SRx generic hardware consists of:

- Battery supply inputs
- DC 5Volt Regulation circuit
- Processor micro-controller
- Serial single-wired link communication
- Variants Rx module control & support
- External RF antenna
- Main connector
- RF Antenna connector
- Ground.

Figure 1: SRX system Block diagram

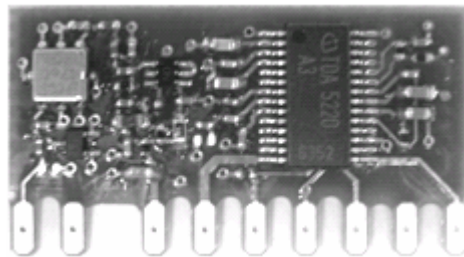


2.1.1. Application for KOR-baby board receiver (TDA521X)

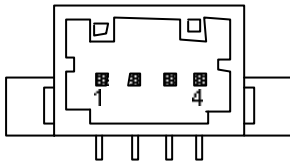


"KOR-baby board" receiver pictures

- PCB terminated pinning type (9 in/output pins)
- Manual placement on the mother board PCB.
- Vertical Standing assembled on mother PCB
- Enhanced RF sensitivity application, designed by SV Ichon

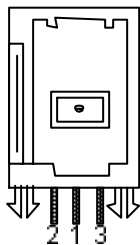


Digital / physical inputs	Pin NO	Task description
SRX_COM	X1-1	SRX Data line (serial Interface)
N.A	X1-2	N.A reserved
V_BAT	X1-3	Battery power supply input (9 V ~16V)
GND	X1-4	SRX ground



2.2.2. RF antenna connector X2

Digital / physical inputs	PIN	Task description
RF ANT-IN	X2-1	RF antenna signal input
GND	X2-2	Ground1
GND	X2-3	Ground2



3. Function electrical description

3.1. SRX Operation Modes

The SRX can operate in three different modes – RKE Mode, PASE Mode and Stand by Mode.

Additionally the SRX has a Sleep Mode where the power consumption is reduced to a minimum.

3.1.1. RKE MODE

In the RKE Mode the following functionalities are available:

	Parameter	description
1	RF data reception	Be available
2	Duty cycle	Be operated (PDWN_SMD & PDWN_KFSK)
3	SRx –bus communication	Be available
4	Battery voltage observation	Be observed
5	RSSI measurement	Be available only for SMD receiver needed
6	Contact- cleaning	Be available

3.1.2. PASE MODE

In the PASE Mode the following functionalities are available:

	Parameter	description
1	RF-PASE data reception	Be available
2	Duty cycle	Be operated (PDWN_SMD & PDWN_KFSK)
3	SRx –bus communication	Be available for PASE reception results
4	Battery voltage observation	Be observed
5	RSSI measurement	Be available only for SMD receiver needed
6	Contact- cleaning	Be available

3.1.3. SLEEP MODE

The Sleep Mode must be initiated by sending a request message via serial link. The SRX does not operate in the Sleep Mode. To leave the Sleep Mode the host module must send a wake-up message to the SRx. After the SRx was woken up from the Sleep Mode it will go into the Standby Mode for 500 ms.

	Parameter	description
1	RF-PASE data reception	Not available
2	Duty cycle	Duty -off (PDWN_SMD :Low / PDWN_KFSK:High)
3	SRx –bus communication	Be available
4	Battery voltage observation	Be observed
5	RSSI measurement	Not available only for SMD receiver needed
6	Contact- cleaning	Be available

3.1.4. STAND-BY MODE:

The Stand by Mode is entered by an interrupt from the RxD input (falling edge interrupt) when the SRx is in the sleep mode. In Stand by Mode the SRX-Bus communication is fully available for 500 ms after the SRx oscillator is stable.

In the STAND-BY Mode the following functionalities are available:

	Parameter	description
1	RF-PASE data reception	Not available
2	Duty cycle	Duty -off (PDWN_SMD :Low / PDWN_KFSK:High)
3	SRx -bus communication	Be available
4	Battery voltage observation	Be observed
5	RSSI measurement	Not available only for SMD receiver needed
6	Contact- cleaning	Be available

Note: In SLEEP MODE the SRx does go into the micro controllers stop operation, where the system clock is switched off to save power. Thus leaving the SLEEP MODE takes some time until the oscillator is properly operating again.

Note: The function of both Sleep mode and Stand-by mode is realization depending on systematically implementation with a host module for the current consumption saving strategy.

3.2. Duty control for PDWN

The Receiver power supplied by duty periodical control with the processor output port as PDWN_SMD / PDWN_KFSK

Corresponding receivers required the input level voltage as below

Main power duty supply control for KOR-baby (as port PDWN SMD)

(Power supply voltage Vs=5V, 1%)

	Parameter	Min	Typ	Max	Unit	Remark
1	KOR (receiver OFF)	0		0.8	V	
2	KOR (receiver ON)	2.8		Vs	V	

3.3. Modulation selection for MSEL

The function is available to use only for SMD-receiver/ KOR-baby board, required for the modulation selection with the processor output port as MSEL.

	Parameter	Min	Typ	Max	Unit	Remark
1	MSEL for ASK modulation	1.4		4	V	
2	MSEL for FSK modulation	0		0.2	V	

Note) Hardware reserved the fixed resistor to short the MSEL port to the ground in order to prevent the case of floating leakage.

3.4. RSSI (received signal strength indicator) for Range reduction

The function is available to use only for SMD KOR-baby board, required for the RSSI range reduction with the processor output port as RSSI.

This pin provides a signal related to the input level of the received signal. This received field strength information can be used to support range reduction. Range is reduced by pulling the RSSI port to VCC via a series resistor R.

RSSI Output Electrical Characteristics with Ext load resister 390k 5%

	Parameter	Min	Typ	Max	Unit	Remark
1	V _{RSSI}	0.8		2.8	V	
2	I _{RSSI}	400		1400	μA	
3	I _{RSSI} (leakage)			2000	nA	

In order to appalling of range reduction function with RSSI signal properly should be implemented carefully with a given detail RSSI characteristic including temp curve form provided the device receiver.

3.5. Demodulated data out for RF_DATA

After process of demodulation by corresponding receiver, which data telegram transfer to the input port as RF_DATA.

3.5.1. Data Output Electrical Characteristics:

For KOR-baby board receiver, Vs=5V, 1%

	Parameter	Min	Typ	Max	Unit	Remark
1	High output voltage	Vs-1.3		Vs-0.7	V	
2	Low output voltage	0		0.2	V	

3.6. SRX Data line (serial Interface) SRX_COM for RxD / TxD / WAKEUP

The SRX have two system configurations for support an RKE –only system (BCM) and PASE PIC with bi-directional communication line. The communication speed is 2.4k baud for BCM or 9.6k baud for PASE PIC,

After a valid SHARK RKE telegram was successfully received the SRx must transmit the RKE data to the host module via serial link. Special care has to be taken for the following cases.

And for the data serial line full-up condition is a corresponded host module has to be full-upped to battery voltage with a resistor values 1.2K Ohm

3.7. Battery voltage reference observation

To observe the battery voltage with the processor input port as VREF

At the V BAT input line.

	Parameter	min	Typ	max	Unit	Remark
1	Over voltage threshold range	16		16.8	V	
2	Under voltage threshold range	8.5		9	V	

4. SRx System Electrical Specification

4.1. Operating Temperature Range of SRx

	Parameter	Min	Typ	Max	Unit	Remark
1	Operating temperature range	-40		+85	°C	
2	Storage temperature range	-40		+85	°C	

4.2. Operating Voltage Range of SRx

	Parameter	Min	Typ	Max	Unit	Remark
1	Operating voltage range [U _b]	9		16	V	VBAT
2	Reverse voltage protection			-13	V	For 5 minutes

The system has to operate at a DC voltage of $U_b=9V$ to $16V$. The communication over the data line is limited between $9V$ to $16V$.

Out of $9V$ - $16V$ range, the system must not operate, but no malfunction is allowed.

The normal operating voltage is $U_b=12.8V \pm 0.2$ during the IGN off and the operation voltage is $U_b=13.8V \pm 0.2$ V duration IGN on.

4.3. Quiescent Current [I_s]

If the system is at RKE –stand by condition (no communication action active) the worst case quiescent current must not be higher than I_s over the whole working range [U_b] and under worst case surrounding characteristics normally present in plants, different climate and temperature zones where the vehicle could be used by the customer.

The typical quiescent current must not be higher than [I_{tp}] at $12.8V$ and at room temperature ($RT=25^\circ C$)

	Parameter	description
1	$I_{tp}@12.8V/RT$	< 3.5 mA

Note:

For typical quiescent current measure with the average values during the SRx on duty cycle running (vehicles under parking mode completely)

The quiescent current in receiver off mode (all SRx functions is stopped)

	Parameter	description
1	$I_{tp}@12.8V/RT$ (without LNA)	< 0.5 mA
2	$I_{tp}@12.8V/RT$ (with LNA)	< 0.5 mA

Under worst case conditions ($16V$, $85^\circ C$) the current $I_{worst\ case}$ may increase by 20% of I_{tp} .

Note:

For the current measuring use only a correct tool with a maximum measurement range to 100 mA

5. Micro-processor description

The processor of the SRx was selected as 8-bit Single-chip NEC's Micro-controller with 78KO series $\mu PD780XXX$. Target processor is $\mu PD780102$ with masked. But for the development support, the SRx will be used with flash memory processor $\mu PD78F0103$ in order to offer facilities to SW development.

The Micro controller $\mu PD780102$ has the following memories:

- Internal ROM 16K bytes
- High speeds RAM 768 bytes
- Memory space 64K bytes
- CPU system Clock 4.953 MHz with ceramic resonator
- Support the Flash memory programming

6. RF technical description

6.1. RF input sensitivity

There are two of definitions for the RF input sensitivity, first of case is integrated with LNA circuit for high gain antenna performance, second of case is no integrated with LNA circuit as by passed LNA routing to the receiver RF input.

6.1.1. RF input sensitivity

For KOR-baby board FSK receiver @ conducted

Frequency	Variant	Data Rate [kbit/s]	Typical sensitivity [dBm]	Min. sensitivity @RT [dBm]
			FSK ±35kHz dev.	FSK ±35kHz dev.
315.00 MHz	5WY 8230 (1k)	1	- 111	-108

Input sensitivity at center frequency, BER 10^{-2} ($V_{cc} = 5V$)

6.1.2. RF data output demodulation polarity

ASK

RF Signal	RF On	RF Off
RX DATA output	HIGH	LOW

FSK

RF Signal	RF on	RF Off
RX DATA output	HIGH	HIGH random (from noise FM compared)

7. System compatibility with TX Frequency Tolerance

System compatibility with TX Frequency Tolerance is restricted, in order to stay (for the worst-case scenario) within **3 dB sensitivity degradation**.

7.1.1. 3 dB sensitivity degradation

Max tolerance of transmitter frequency from nominal carrier frequency ("min. sensitivity 3 dB bandwidth"):
The transmitter should be considered enough as below

For KOR-baby board receiver

T = -40° to +85°C					
Frequency band	Max. allowed deviation of TX frequency from nominal frequency				
			FSK ±35kHz deviation		
315 MHz			-70 kHz	+44 kHz	
			-222 ppm	+139 ppm	