# Highways Safety in Egypt

**M. A. Massoud**

***Abstract* —** Highways Safety is one of the most important topics in Egypt, because of the numbers of victims are increasing rapidly by accidents. This paper introduces a new Technique to deal with speed limit of the vehicle on the high roads. This system consists of two units a transmitter unit and receiver unit. At the entrance of the highway the transmitter unit is built. The vehicles have a receiver unit and received signals to limit speed by radio frequency signals. The technique can assist human drivers in difficult road circumstances.

***Keywords*—** safety road, throttle position sensor, license plate recognition, car receiver unit.

## I.INTRODUCTION

According to WHO Global Status Report on Road Safety, Fig. 1 Shows a road traffic fatality rate of deaths per 100 000 population in Egypt until 2010. In 2011 the total accidents on highways were 2000 accidents. There were 1000 dead and 4400 injured persons. This number is increased to be 12 000 lives due to road traffic crashes in 2014. The statistics showed that 58.4% of accidents were caused by the human element; 30.6% as a result of defects in the car, the rest distributed to environmental factors and weather conditions. In the cities the 90-95% of the traffic accident is occurred by the driver errors [1- 4].

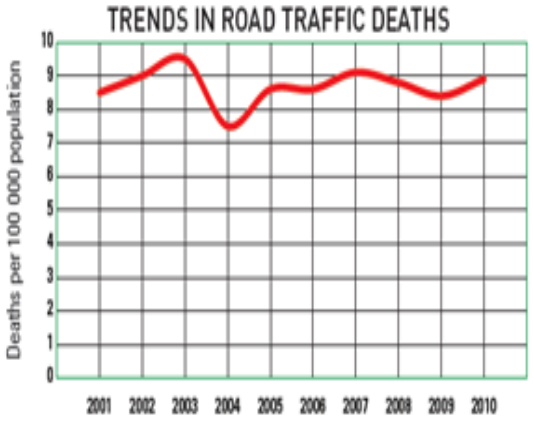


Fig.1 The trends in traffic deaths in Egypt.

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Human errors occur by many factors such as; high speed, careless drive, overweight trunk, Overhight trunk, and bad driver attitudes [5].

Education, mass media campaigns, and police enforcement are very important factors which lead to minimize road accident by changing the driver behaviors [6-8].

The ministry of transport statistical and many other statistical spotted the technical opinion of the passage about the causes of accidents, and the outcome that came speeding in the first place [9].

Accident caused by high speed has become a serious health problem [10].So that the speed limiter plays the main function that can eliminate high speed accidents.

There are many researches in the speed limiter field. The driver behavior improved when speed is limited by using Automatic Speed Control [11-13] and Intelligent Speed Adaptation (ISA) systems. Automatic Speed Control is reduced and adaptive speed. The ISA can separate into three types of system; advisory, advisory intervention, and mandatory intervention[14-21]

Cruise control system (CCS) and adaptive cruise control (ACCS) are the systems belong to ISA. In ACCS a constant speed and the safe distance from the preceding vehicle can be taken [22, 23]. This introduced system belong to ISA system which is maintain and limit speed at highways in Egypt.

## II. METHODOLOGY

The proposed technique was designed to decrease highway accidents and enhance the driving safety. According to traffic department rules in Egypt, the maximum speed of desert ways are; 60 km/h to tractor and semi trailer cars, 80km/h to transport cars, 90 km/h for passenger cars, and 100 km/h for the rest types of cars [24]. Therefore the setting of maximum speed depends on the vehicle type.

The system consists of a transmitter (TX) unit and a car receiver (RX) unit. The TX unit is designed to establish at highway entrance. It is composed of License Plate Recognition (LPR), controller, and transmitter module. In the car receiver (RX) unit, the receiver module receives RF signal and sends it to Arduino controller. Fig. 2 shows the block diagram of transmitter unit.

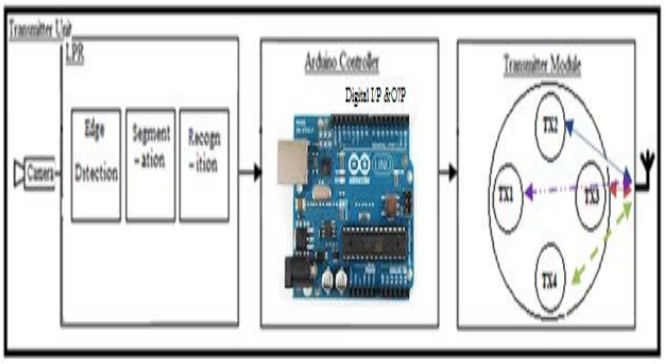


Fig.2 The block diagram of the transmitter unit.

The first step in this technique depends on acquiring Image. The camera takes video input of vehicle to access the image acquisition device, then capture one frame of data and determine the image resolution.

Image is a two-dimensional function of the form f(x, y). This function is characterized by two components: the amount of source illumination incident on the scene being viewed, and the amount of illumination reflected by the objects in the scene.

$$f(x,y) = i(x,y)r(x,y) \qquad (1)$$

Where $i(x,y)$ *is the* **incident illumination**, and $r(x,y)$ *is the* **reflected illumination**.

So the source illumination incident is very important and high spotlight must be used at the highway entrances.

There are many techniques used image processing [25-29]. Image processing is the backbone of LPR technique.

License Plate Recognition technique in [30] is used. This technique is designed to extract and recognize LPR. The LPR algorithm consists of edge detection, segmentation, and recognition methods.

In edge detection, the Sobel edge detector is used to find rectangle of the plate using dilation and erosion. Then the 2D median filter mask $5 \times 5$ is used to filter and smooth the eroded image. After edge detection, segmentation technique is applied.

The objects are extracted from an image in the segmentation process. The size of a new Egyptian license plate is 17cm ×32cm as shown in Fig. 3. It is consisted of three parts. The first part is a high part of the plate. The size of this part is 62mm ×32cm. It contains words of Egypt by Arabic and English, a background color of this region refers to a type of car (private, taxi, ...). The reminder region is divided vertically into two regions; right for plate characters, and left half contains numbers. By analyzing the first part of the original image using color filter to obtain the type of car. The segmentation process can get each character and number separately.


Fig. 3 The Egyptian license plate.

In recognition methods, the database of characters and numbers are correlated with vehicle characters and numbers to recognize it.

So that the color of the first part of the plate is very important to recognize the type of the vehicle. TABLE I illustrates type of the vehicle corresponding to color of LPR.

TABLE I Database of vehicles refer to their colors.

| Color | Refers to |
|---|---|
| Light blue | Private vehicles |
| Orange | Taxis |
| Red | Trucks |
| Gray | Buses |
| Beige | Limousines and tourists' buses |
| Green | Diplomatic vehicles |
| Yellow | Vehicles with unpaid customs |
| Dark blue | Police vehicles |

These colors are storage for the sample region as color name{'red', 'green', .....act}, then Create an array that contains color labels; red=1,green=2 and so on. After that compute the correlation coefficient between the stored image and the image processed by a median filter. The next equation computes the correlation coefficient

$$r = \frac{\sum_m \sum_n (A_{mn} - \bar{A})(B_{mn} - \bar{B})}{\sqrt{\left(\sum_m \sum_n (A_{mn} - \bar{A})^2\right)\left(\sum_m \sum_n (B_{mn} - \bar{B})^2\right)}} \qquad (2)$$

where A and B are matrices or vectors of the same size.

$\bar{A}$ = mean (A), and $\bar{B}$ = mean (B).

Correlated color is defined by highest correlation coefficient. According to traffic department rules in Egypt, LPR vehicle color can define vehicle speed at the desert ways.

The prototype of introduced system is shown in Fig. 4(a) and Fig. 4(b) shows the proposed highway entrance. It uses a camera sensor and the LPR technique to detect the car type and send signal to the Arduino controller, which has four outputs related to traffic department rules in Egypt. One output only of Arduino controller outputs will work related to LPR vehicle color. Arduino sends the signal to nRF24L01 TX module.


Fig. 4 The prototype system and proposed entrance.

The nRF24L01 is a single chip radio transceiver with 2.4 GHz. The transceiver consists of a fully integrated frequency synthesizer, Enhanced ShockBurst™ protocol engine and many other features. The primary RX (PRX) of nRF24L01 can able to receive data trough 6 different data pipe as illustrates in Fig. 5. These data pipe have a unique address, but work at the same frequency channel. So that the 6 difference nRF24L01 of primary TX (PTX) can communicate with one nRF24L01 configured as PRX. The PRX can demonstrate, among the 6 PTX. The nRF24L01 configured as PTX with Enhanced ShockBurst™ enabled and send a packet whenever the microcontroller wants to send its[31].

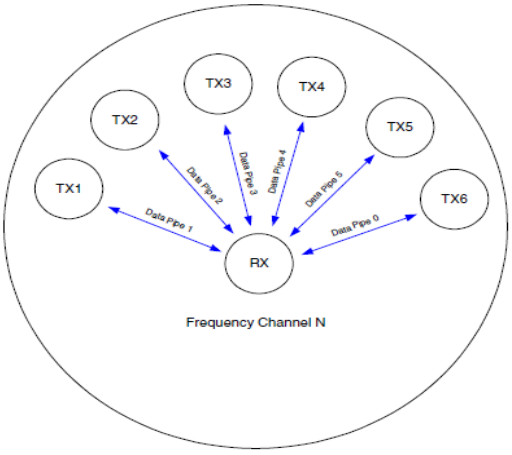


Fig.5 The nRF24L01 in a star network configuration.

This system has four PTXs located in the entrance and one PRX for each vehicle. One of PTXs will work according to Arduino signal that received. The PTX unit transmits radio frequency (RF) signal to the car PRX unit.

Modern cars use engine control unit (ECU) as a new control system. ECU is a type of electronic unit that controls a series of actuators on an internal combustion engine to get optimal engine performance. Air/fuel mixture, idle speed, electronic valve, and ignition timing are controlled by ECU. In the engine fuel injection, ECU determines the quantity of the air/fuel injection. Fig. 6 shows the block diagram of the proposed technique.

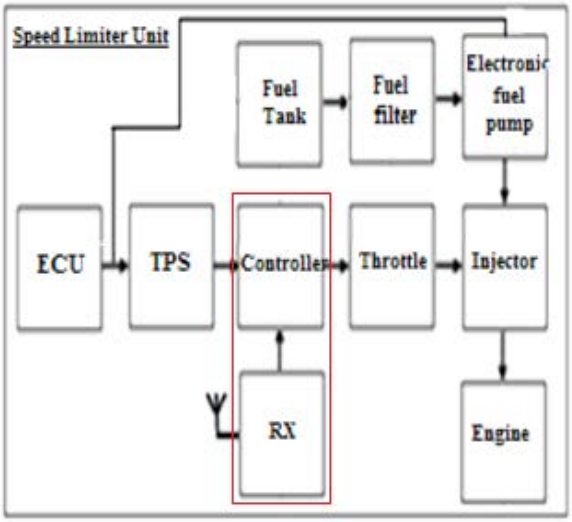


Fig. 6 The block diagram of the proposed technique.

ECU sends a signal to throttle position sensor (TPS) which uses to control the throttle opening or closed depending on gas pedal. The TPS is a simple electronic potentiometer device. Fig. 7 shows the TPS and wire connection.

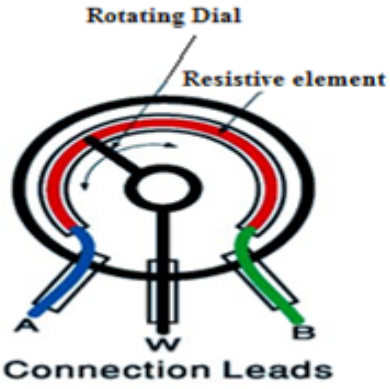


Fig. 7 The TPS and wire connection.

Fig. 7 shows three wires connected to potentiometer namely A, B, and W. Wire A is related to a reference voltage (5 volt), B is a ground (0 volt), and W is a control signal. The control signal is a signal which controls the throttle to open or closed. A throttle is a butterfly valve that is controlled in air flow to mix with fuel. The throttle is wide open at high speed and vice versa. Fig. 8 shows the throttle and TPS in the car engine

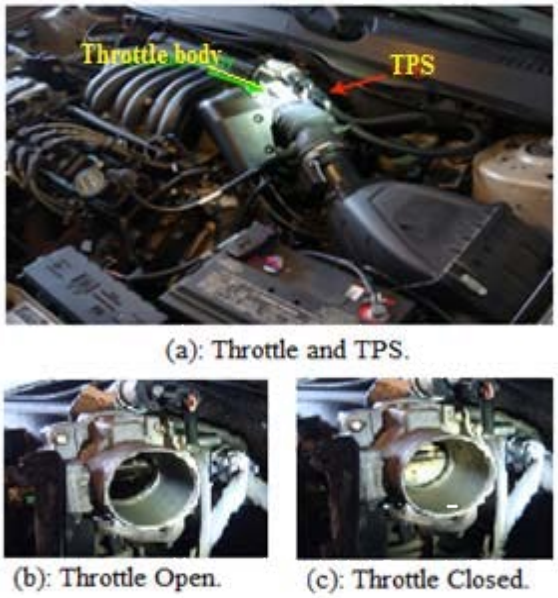


Fig. 8 The Throttle and TPS

The system is design to control in the throttle by Arduino controller. At the entrance of the desert way, the TX sends thesignal then the car RX receives this signal.

The Arduino controller works by the RX signal as illustrated in Fig. 6. If car speed is less than or equal permissible speed the Arduino applies TPS voltage, otherwise the Arduino voltage applies following equation:

$$\text{Arduino output voltage} = 5V \times \alpha/\zeta \qquad (3)$$

where:

$\alpha$ is a permissible speed of highway,

$\zeta$ is a maximum car speed.

The throttle is controlled by Arduino output voltage. Fuel mixes with throttle air in the carburetor (injector) to feed an engine and reduce the car speed. The RX prototype system illustrates in Fig. 9.

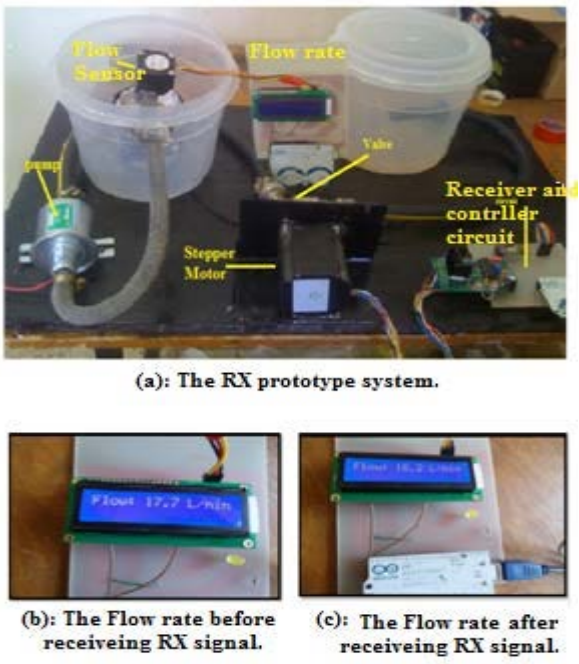


Fig. 9 The RX prototype system and Flow rate before and after RX signal .

The electric circuit of the prototype stepper motor shows in Fig. 10.

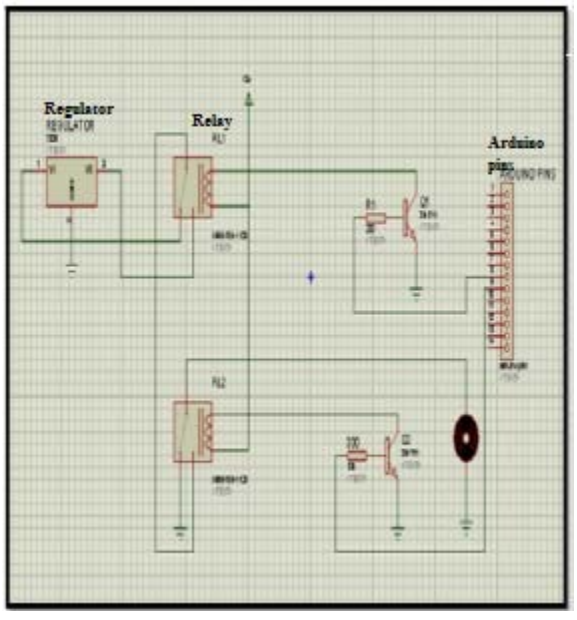


Fig. 10 The electric circuit of the prototype stepper motor.

## III RESULTS

The system had been tested to measure the performance and accuracy. The prototype system was tested 30 times, a half of them without using TX signal. Twelve of fifteen were success to maintain a desire speed without using TX signal. By using TX signal all tested conditions were success to maintain a desire speed. So that the accuracy increase from 80% to 100% to limit speed by using introduced system. TABLE II illustrates the results of testing system and Fig. 11 shows the accuracy of the system.

TABLE II The results of tested system.

| | Testing Without TX signal | Testing With TX signal |
|---|---|---|
| Number of testing system | 15 | 15 |
| Maintain a desire speed | 12 | 15 |
| System accuracy | 80% | 100% |

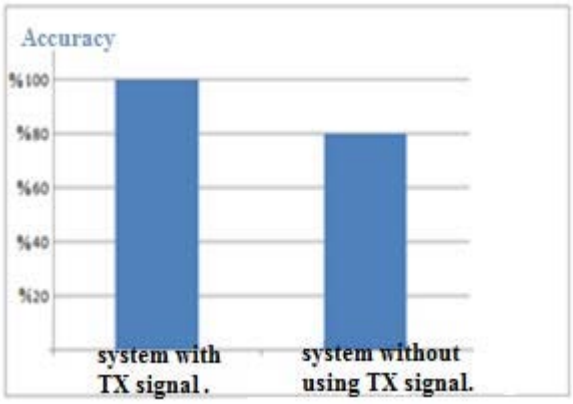


Fig. 11 The accuracy of the system.

## IV. CONCLUSIONS

This paper introduces an architecture for automatic adaptation of the speed of the vehicles in Egypt. The system allows the efficient adaptation of the speed of the vehicle to the circumstances of the road to avoid the speed accidents. The prototype study evaluated speed limiter control in terms of TX and RX signals. The results were successfully by using this technique. The high spotlights must be used at the highway entrances to increase the performance of the LPR. Moreover the system can apply in special regions as schools, hospitals, and government buildings.

## REFERENCES

[1] .Ahram journal Available: http://www.eip.gov.eg/ Upload/ Documents/ 522/ SUM/Intro.pdf
[2] DETR , "New directions in speed management," A review of policy, Eland House, London, UK, 2000.
[3] Almasryalyoum journal Available: http:// www.almasryalyoum.com/ node/ 1015861
[4] Egypt- world health organization Available: http://www.grsproadsafety.org/sites/g/files/g423576/f/201503/Egypt.pdf
[5] Mohamed A. Massoud, " Over-Height Vehicle Detection System in Egypt," WCE 2013, ICEEE2013, London, U.K., 3 - 5 July, 2013.
[6] Carstensen, G., "The effect on accident risk of a change in driver education in Denmark," Accident Analysis & Prevention 34(1), 2002, page 111-121.
[7] Delaney, A., Lough, B., Whelan, M., Cameron, and M., "Review of mass media campaigns in road safety," Monash University Accident Research Centre, Melbourne, Australia, 2003.
[8] Armour, M. "A review of the literature on police traffic law enforcement Australian Road", Australia, 1984, Research Board: 17-25.
[9] Rumar, K. "The role of perceptual and cognitive filters in observed behavior," VTI särtryck 111 A, VTI, Linköping, Sweden, 1986.
10] Omaima Bamasak, Ghadah Al Mehmadi, Amal Al-Ghamdi , Arwa Al-Mutawa, and Mashael Al-Ghamdi,"Monitored Intelligent Car Speed Adaptation (MISA) System," International Journal of Electrical & Computer Sciences IJECS-IJENS Vol: 11 No: 03 1, 113203-7575 IJECS-IJENS © June 2011 IJENS I J E N S.
[11] Nilsson, L., Berlin, M. "Driver attitudes and behavioral changes relatedto presentation of roadside information inside the car," A pilot study of the CAROSI system, VTI-meddelande 689 A, Linköping, Sweden, 1992.
[12] Carsten, O.,and Comte, S. "UK Work on Automatic Speed Control," Proceedings of the ICTCT 97 conference, 5-7 November 1997, Lund, Sweden, 1997.
[13] Comte, S., "Intelligent Speed Adaptation: Evaluating the possible effects of an innovative speed management system on driver behavior and road safety," University of Leeds, Leeds, UK, 2001.
[14] Päätalo, M., Peltola, H., Kallio, M.,"Intelligent speed adaptation –effects on driving behaviour," Traffic safety on three continents, Moscow, Russia, 2001.

15] Persson, H., Towliat, M., Almqvist, S., Risser, R., Magdeburg, and M.,"Speed-limiters in cars. On-road study on speeds, behavior, conflicts and drivers comments when driving in built up areas, In Swedish," Lund University, Lund, Sweden, 1993.
[16] Duynstee, L., Katteler, H., Martens, G., "Intelligent Speed Adaptation: Selected results of the Dutch practical trial," Proceedings of the 8th ITS world congress, Sydney, Australia, 2001.
[17] Päätalo, H. Peltola and M. Kallio. "Intelligent Speed Adaptation-Effects on driving behavior,_, in Proc.7th European Congress on ITS, 2001, pp. 1-10.
[18] Lahrmann, H., Runge, J., and Boroch, T. "Intelligent Speed Adaptation – Development of a GPS based ISA-system and field trail of the system with24 test drivers," Aalborg University, Aalborg, Denmark, 2001.
[19] Joshué Pérez, Fernando Seco, Vicente Milanés, Antonio Jiménez, Julio C Díaz, and Teresa De Pedro, "An RFID-Based Intelligent Vehicle Speed Controller Using Active Traffic Signals," MDPI Publishing, Sensors 2010, Volume: 10, Issue: 6, Pages: 5872-5887
20] Hsieh, W.H., Ho, C.J. Jong, and G.J.,"Vehicle Information Communication Safety Combined with Mobile RFID," International Conference on Intelligent Information Hiding and Multimedia Signal Processing, Harbin, China, August 15–17, 2008.
[21] Sato, Y. "Makane, K. "Development and Evaluation of In-Vehicle Signing System Utilizing RFID Tags as Digital Traffic Signals," Int. J. ITS Res. 2006, 4, 53–58.
[22] Lusetti , B. Nouveliere, L. Glaser, S. Mammar ,and S., "Experimental Strategy for A System Based Curve Warning System for A Safe Governed Speed of A Vehicle", IEEE Intelligent Vehicles Symposium. Eindhoven, the Netherlands, June 2008; pp. 660–665.

[23] Van Nes, N.; Houtenbos, M.; Van Schagen, I. "Improving Speed Behavior: the Potential of In-Car Speed Assistance and Speed Limit Credibility", IET Intel. Transp. Syst,no2. 2008, page 323–330.

[24] Central traffic department Available: http:// www.moiegypt.gov.eg/ Arabic/ Departments%20Sites/ Traffic/ QandA/ Sor3atMokarara

25. Ukil Yang, Minsung Kang, Jongin Son, Kwanghoon Sohn, in Image Color Registration for Illumination-Robust Pattern Recognition. Circuits, Systems, and Signal Processing, December 2014, Volume 33, Issue 12, pp 3839-3860
26. Filomila Kafe, Farooq A. Khanday, Costas Psychalinos, in A 50 mHz Sinh-Domain High-pass Filter for Realizing an ECG Signal Acquisition System. Circuits, Systems, and Signal Processing, December 2014, Volume 33, Issue 12, pp3673-3696
27. Shuigen Wang , Dongshun Cui, Baoxian Wang, Baojun Zhao, Jinglin Yang, in A Perceptual Image Quality Assessment Metric Using Singular Value Decomposition. Circuits, Systems, and Signal Processing, January 2015, Volume 34, Issue 1, pp 209-22
28. Antonio Rama, Francesc Tarrés, Jürgen Rurainsky, in 2D-3D Pose Invariant Face Recognition System for Multimedia Applications. Recent Advances in Multimedia Signal Processing and Communications, 2009, Volume 231 of the series Studies in Computational Intelligence pp 121-144
29. Jun-Bao Li , Shu-Chuan Chu, Jeng-Shyang Pan, in Statistical Learning-Based Face Recognition. Kernel Learning Algorithms for Face Recognition, September 2013, pp 19-47
30. M. A. Massoud, M. Sabee, M. Gergais, and R. Bakhit ," Automated New License Plate Recognition in Egypt", Elsevier , Alexandria Engineering Journal, AEJ123, 13 Mar 2013.
31. PRELIMINARY PRODUCT SPECIFICATION, Single chip 2.4 GHz Transceiver nRF24L01. NORDIC Semiconductor

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