

() , ()

(VRA)

*

(// : // :)

(VRA)

(SSCM)

(DI)

(GPS)

()

()

%

(GPS)

(DI)

(VRT)

:

.(Al-Gaadi, 1992)

(VRA)

()

VRA

VRA

.(GopalaPillai, et.al. 1999)

1 Pressure-Based VRA
2 Injection VRA

(Gopala Pillai, *et al.*,

.1999)

()

(PWM)¹

(Gopala Pillai *et al.*, 1999)

(BBA, 2002)

Koo & (1990) Giles & Comino

Tian (1999) Gopala Pillai *et al.*, (1993) Kuhlman

(2000) & Zheng

km/h

r

VRA

) ()

(DI)

(

Frost (1990)

$$T_{\text{delay}} = \sum_{i=1}^n \frac{\pi L_i D_i^2}{4 Q_i}$$

()

) ()

(Stone *et al.*,

(

(s)

: T_{delay}

.1999)

(m)

: L_i

(m)

: D_i

(m³/s)

: Q_i

(DI)^r

: n

1 Pulse Width Modulation

2 Active Ingredient

3 Direct Injection

4 Carrier fluid

(Rockwell & Ayers, 1996)

(VRT)

)

(

(DI)

(T_R)

(DI)

(VRA)

)

()

(DI)

(

DI

()

()

(PLC)

(GPS)

()

()

()

-
- 1 Flow meter
 - 2 Pressure Sensor
 - 3 Rotary Encoder
 - 4 Programmable Logic Controller
 - 5 A to D Module
 - 6 Electrical Conductivity Sensor
 - 7 Differential Pressure Sensor

()

VDC
Hz

rpm

/ hp

L/min

()
Hz (PLC
(DC) *
PWM
() : DC
()

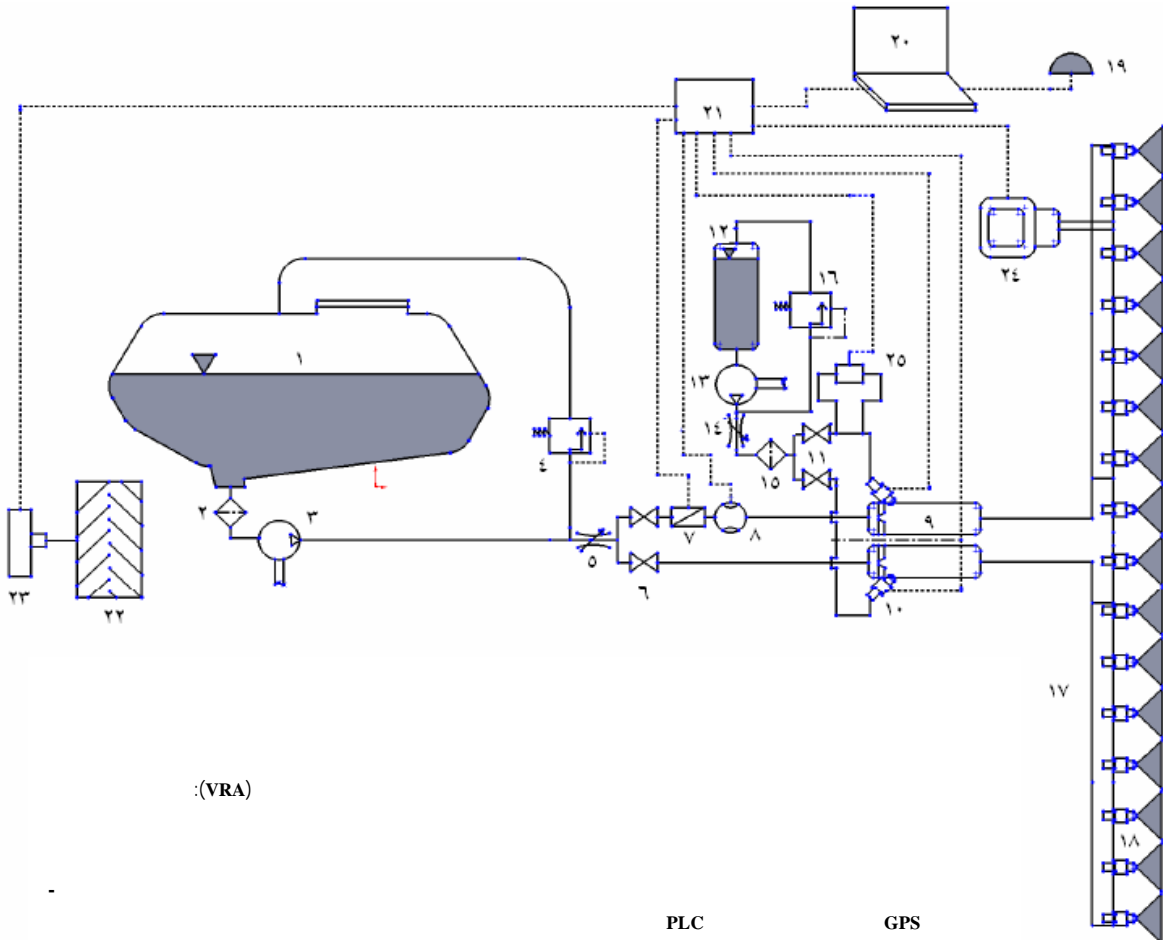
(PWM)

GPS

(Mohammadzamani *et al.*, 2009)

2 چرخه‌ی وظیفه (Duty Cycle) یک موج به صورت نسبت " مدت پالس " به دوره-
ی تناوب پالس تعریف می شود.

1 Solenoid Injectors



()

C++Builder

Visual Basic WinProLadder

cm

cm

cm

()

FBs-24MC

FATEK

kHz

()

kHz

(L₁)

(GPS)

)

NMEA

(

()

L/min

()

bar

USB

()

bar

)

(

()

Burkert 8225 Compact Conductivity

Transmitter

K=1

mS/cm

μS/cm

LCD

mA

()

PLC

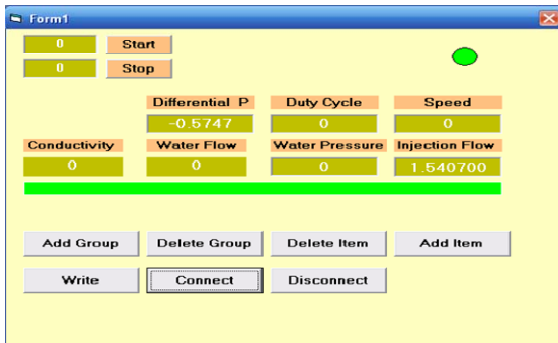
PLC
PLC
PLC
Visual Basic
Visual Basic
) C++Builder
(ΔP)
PLC WinProladder (
() Visual Basic
) C++Builder mA
) WinProladder (mbar
VB¹ (PLC .()
VB ()
GPS
() C++Builder
Open
(Grid.txt)
Setting.txt
) Setting.txt
) Setting.txt
(GPS GPS
GPS
PLC
VRA
WinProladder PLC
WinProladder
PLC

1. Visual Basic
2. Transient State
3. Steady State

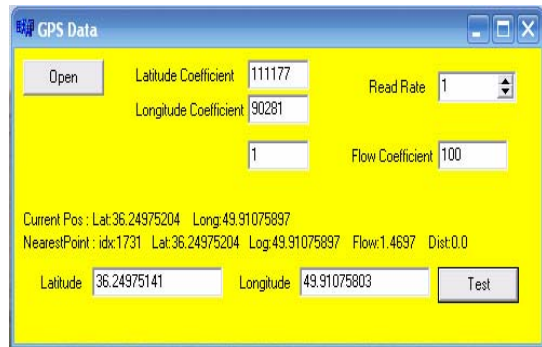
()



GPS (PLC)



VB



C++Builder

%

L/ha

km/h

...

:

/

SPSS 15

/

(km/h

)

)

(L/h

()

%

%

bar

bar

:

() () () ()

bar

D.C=2.5V.IF

()

:

(%)

: D.C

(km/h)

: V

%

(L/ha)

: IF

%

)

()

(

/ s

/ s

%

%

%

L/min

/

L/min

/

MATLAB

()

%

/ mS/cm (

)

F

/

/

/ *

/

/

/

/

g/L

%

*

%

()

%

bar

()

)

(s)	((bar)
/ ^a	
/ ^a	
/ ^a	

(/ / bar

s

()

(s)	((bar)
/ ^b	
/ ^a	
/ ^c	

()

cm

%

bar %

F

bar

/ / ns	/ /
--------	-----

bar %

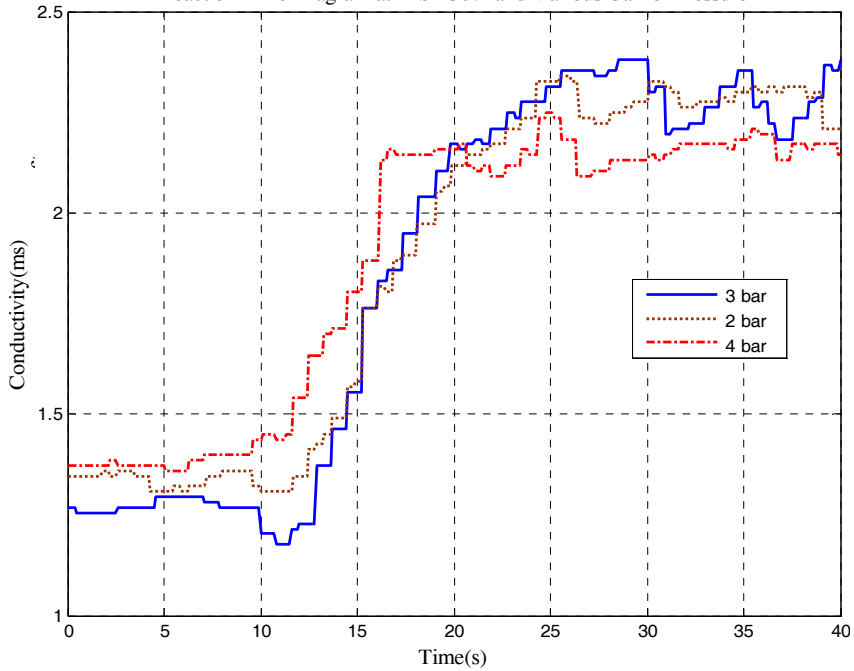
/ /

bar

%

: ns

Reaction Time Diagram at D.S= 30% and Various Carrier Pressure



bar

km/h

%

)

bar

(L/ha

() ()

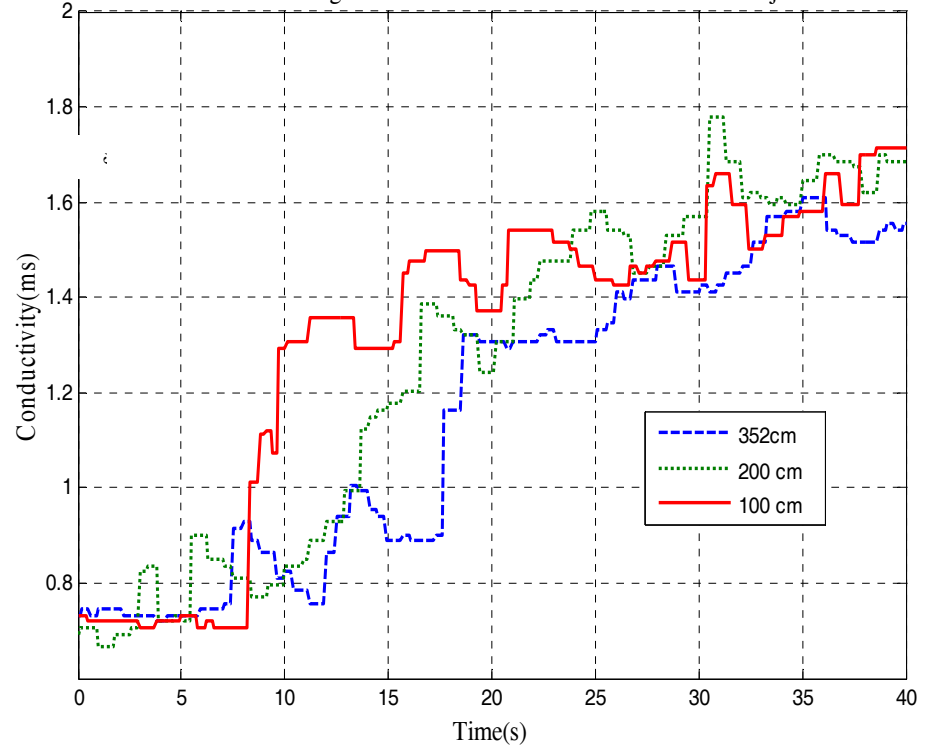
%

()

%		(/ s)	
%			
F			
/	/ *	/	/
		/	/
			/
%		*	

(s)	((cm))	cm
/ ^a			cm
/ ^b			
/ ^c			

Reaction Time Diagram at D.S= 30% and Various Positions of Injection



km/h %) cm bar bar

(L/ha

, ()

()

bar bar

()

.

.

()

()

()

F

/	/	ns	/	/	
/	/	*	/	/	
/	/	ns	/	/	
	/	*	/	/	
/	/	ns	/	/	×
/	/	ns	/	/	×
/	/	ns	/	/	×
/	/	ns	/	/	×
			/	/	×
			/	/	×

:ns

%

:*

()

() :

(DI)

PWM

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