ACS-1000

Analog Control System

*Notebook is excluded.

ACS-1000, covered with many technical disciplines, explicates the central significance of Analog Control System. It applies particularly in mechanical and electrical engineering, and as well in production and process technology . It is indispensable to plant and system technology.

In the automation field, important optimization tasks would be quite impossible to be accomplished without closed-loop control technology. In line with its increasing importance, closed-loop control has become an essential subject in professional training and further education for many professions.

In the newly formulated training curriculum, this technology plays an important role covering a number of subjects in syllabuses for training in industry and the crafts.

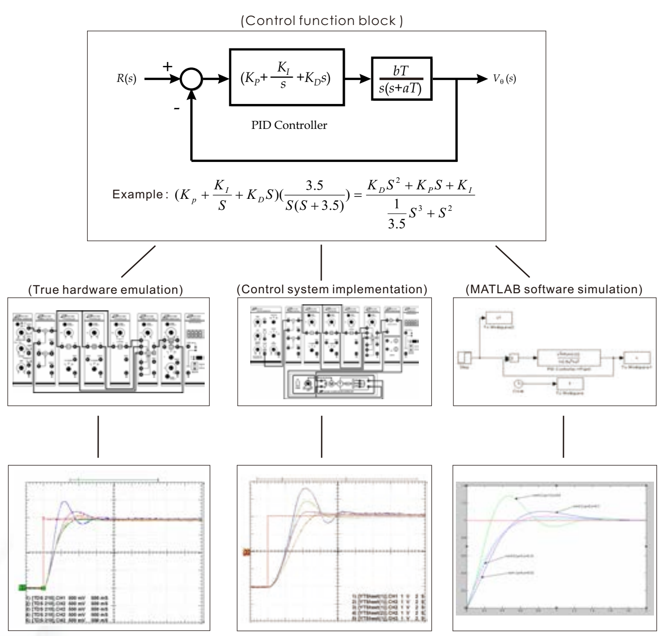
● Features

1. Control engineering is an exciting discipline. It offers the most expedite in way to learn system control for improving production processes. Electronic analog control and simulation have become the cornerstone of technological advancement.
   K&H provides ACS-1000 for students to observe the testing result of Proportional-Integral-Derivative (PID) controllers as well as phase-lag and phase-lead controllers.
2. Modularized ACS-1000 is flexible enough to cater to the needs of all level learners to make related experiments.
3. The whole control modules help students to understand control theory and application of hands-on motor control through our comprehensive and step-by-step teaching curriculums.
4. We also provide PC based data acquisition device as interface to facilitate data storage from computer.

" ACS " is an acronym for "Analog Control System" ; a laboratory teaching system with analog control courses for college and university level .

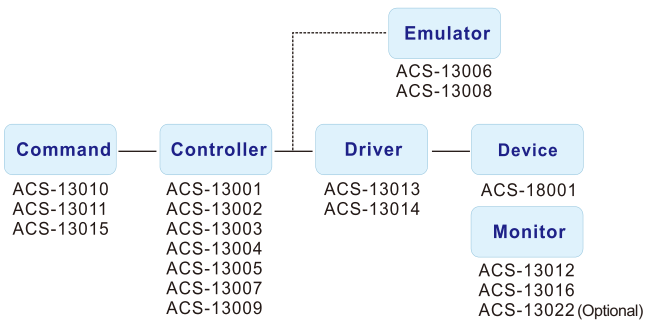
"ACS" is a true hardware arithmetic modeling system

------ Not just a trainer ------



ACS-1000 consists of 17 different plug-in modules and ACS-18001 DC Servo Motor & Control Unit. It comes with an optional extra ACS-13022 Data Acquisition Device (DAQ) . The plug-in modules, sliding into the system rack, can achieve the desired experiment.

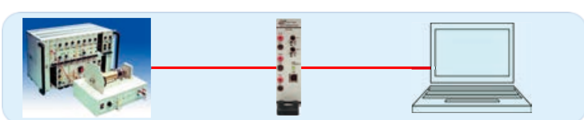
Each ACS-1000 plug-in module offers a fundamental control building block on the panel for making different experiments.



System Specifications

1. With System Integral Frame and Modules
2. Cabinet : 6U, E.I.A. 19" standard
3. DC Power Supply : ±15VDC
4. Module Plug-in Slot : 24
5. Hot Pluggable

Order Information



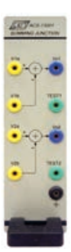
ACS-1000 + ACS-13022 + PC

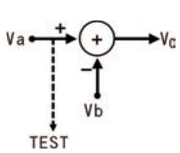
ACS-1000 + PC-Based DSO TSO-1000 + PC

ACS-1000 + DSO + PC

Modules Specification

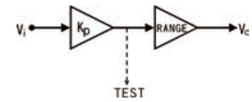
1. ACS-13001 Summing Junction





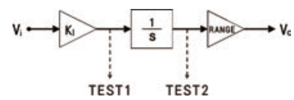
(1) 2 sets of analog signal summation
(2) With over-range test output

2. ACS-13002 P-Controller



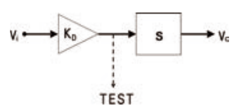
(1) Continuous 0~10 proportional constant K_P (precision10-turn potentiometer)
(2) With push-button R-CAL. 0 for displaying K_P on the 7-segment display of ACS-13016
(3) K_P range selector : x1, x10, x50
(4) With over-range test output

3. ACS-13003 I-Controller



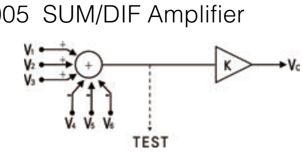
(1) Continuous 0~10 integral constant K_I (precision 10-turn potentiometer)
(2) With push-button R-CAL.1 for displaying K_I on the 7-segment display of ACS-13016
(3) K_I range selector : x1, x10, x50
(4) With over-range test output

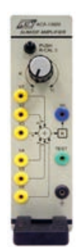
4. ACS-13004 D-Controller



(1) Continuous 0~1 derivative constant K_D (precision 10-turn potentiometer)
(2) With push-button R-CAL.2 for displaying K_D on the 7-segment display of ACS-13016
(3) With over-range test output

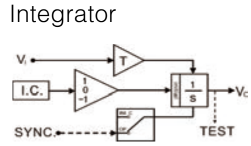
5. ACS-13005 SUM/DIF Amplifier





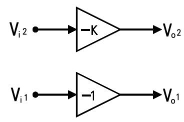
(1) 3 positive inputs and 3 negative inputs for the sum of analog signals
(2) Continuous 0~10 amplifier gain K (precision 10-turn potentiometer)
(3) With push-button R-CAL.3 for displaying K on the 7-segment display of ACS-13016
(4) With over-range test output

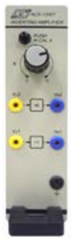
6. ACS-13006 Integrator



(1) Initial value : -10~+10
(2) With synchronous control function
(3) T constant setting : 1, 10, 100
(4) With over-range test output

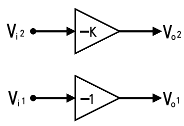
7. ACS-13007 Inverting Amplifier

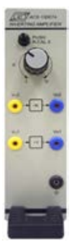




(1) One inverting buffer and one inverting amplifier with gain K of 0~10 (precision 10-turn potentiometer)
(2) With push-button R-CAL.4 for displaying K on the 7-segment display of ACS-13016

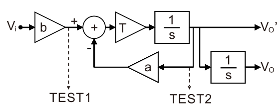
8. ACS-13007A Inverting Amplifier





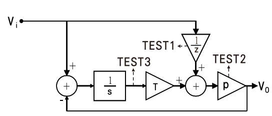
(1) One inverting buffer and one inverting amplifier with gain K of 0~10 (precision 10-turn potentiometer)
(2) With push-button R-CAL.5 for displaying K on the 7-segment display of ACS-13016

9. ACS-13008 Second Order Plant



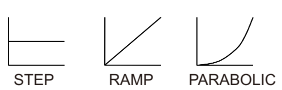
(1) Used for first/second order plant simulation
(2) a and b parameters : 0~10
(3) T parameter : 1, 10, 100
(4) With push-buttons R-CAL.6 and R-CAL.7 for displaying b and a on the 7-segment display of ACS-13016
(5) With over-range test output

10. ACS-13009 LEAD/LAG Compensator



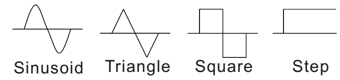
(1) z and p parameters : 0~10
(2) T parameter : 1, 10, 100
(3) With push-buttons R-CAL.8 and R-CAL.9 for displaying z and p on the 7-segment display of ACS-13016
(4) With over-range test output

11. ACS-13010 Test Signal Generator



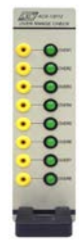
(1) Provide input signals to control systems
(2) STEP generator with positive and negative output
(3) RAMP generator with positive output
(4) PARABOLIC generator with positive output
(5) Amplitude associates with offset : -10V~+10V
(6) Frequency: (precision 10-turn potentiometer)
Range x1 : 0.05Hz~10Hz
Range x10 : 0.5Hz~100Hz

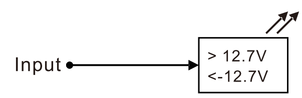
12. ACS-13011 Synthesized Function Generator



(1) Output waves : Sinusoid, triangle, square, step
(2) Step pulse with synchronous control function
(3) Amplitude associates with offset : -10V ~ +10V
(4) Frequency : 0.01Hz~1MHz Continuously adjustable
(5) Amplitude Range : 100mV~18Vpp (open circuit)
(6) Display : 4-digit,7-Segment display
(7) Output impedance : 50Ω

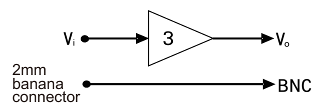
13. ACS-13012 Over Range Check





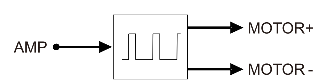
(1) 8 sets of over-range detectors
(2) Over-range indicator illuminates while input exceeding ±12.7V

14. ACS-13013 Analog Power Driver



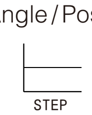
(1) Analog input voltage : 0~± 4V; input impedance : 1KΩ; gain : 3
(2) Analog output voltage : 0 ~±12V; Max output current : 1A
(3) Input amplitude limitation : ±12V
(4) Output with short-circuit and current-limiting protection : 1.5A
(5) 2mm to BNC adapter

15. ACS-13014 DC Servo PWM Driver



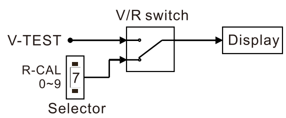
(1) Analog input voltage : 0~±12V
(2) Input impedance : 100KΩ
(3) PWM output : 0~+12V, bridge PWM drive, Max. output current : 1A
(4) With dead band elimination for protection
(5) Output with short circuit and current-limiting protection : 1.5A

16. ACS-13015 Linear VR Angle/Position Sensor & Buffer



(1) Resistance : 1KΩ
(2) Linearity : 0.1%
(3) Detecting angle : 0 ~ 350°
(4) Angle to analog output voltage : -5V~+5V
(5) Output impedance : 1KΩ

17. ACS-13016 Calibration & Testing Module



(1) V-TEST analog input voltage : -15V~+15V
(2) R.CAL : R-CAL.0 ~ R-CAL.9 parameters
(3) Display : 3 ½ digit, -19.99V~19.99V or 0.00~100.0KΩ

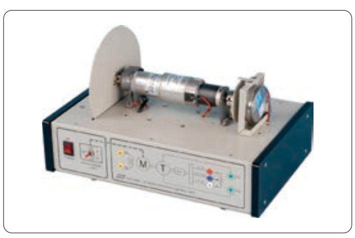
18. ACS-13022 Data Acquisition Device (DAQ)

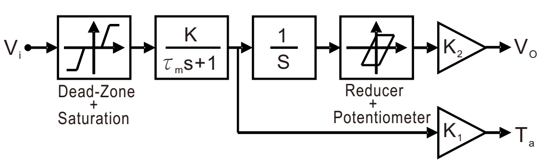
ACS-13022 DAQ module with software interface is used to measure and record all experimental waveforms.

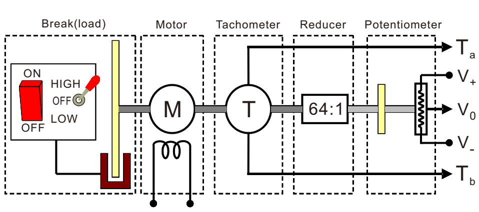
(1) Channel Vi1/ Vi2 :
Input range
X1 : -10V~+10V
X2 : -20V~+20V
Bandwidth : 500Hz
Sample rate : 5000S/s
(2) Channel Vo
Output range : DC -5V~+5V
(3) Connective : USB port on the front panel

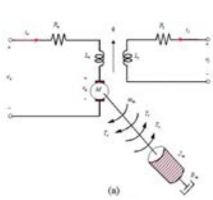
System requirement
1. PC : 1GHz or faster 32-bit (x86) or 64-bit (x64) processor, 2GB RAM, 1GB more free disk space
2. OS : Windows XP / Vista / 7 / 8 / 10

19. ACS-18001 DC Servo Motor & Control Unit









DC servo motor & control unit can be provided for speed & position control.
(1) DC servo motor
a. Voltage : 24VDC
b. No-load current : 100mA +30%
c. No-load speed : 3800rpm ± 20%
d. Terminal resistance : 11.27Ω ± 15%
e. Terminal inductance : 8.2mH ± 10%
f. Torque constant : Kt = 0.567Kg-cm/A ± 20%
(2) Co-shaft tachometer
Back EMF : Ke = 6.00V/Kr.p.m. ± 15%
(3) Gear-coupled linear VR for angle detecting
a. Gear ratio : 64:1
b. Impedance : 1KΩ
c. Linearity : 0.1 %
d. Detecting angle : 0 ~ 350°.
(4) Co-shaft eddy current load
Load level selector : High=100 Gr-Cm, Low=10 Gr-Cm, OFF=0 ± 20%

List of Experiments

1. Laplace Transform
2. System Simulation
3. Steady-State Error
4. First-Order System
5. Second-Order System
6. Transient Response Specifications
7. Effects of Zero on First-Order System
8. Effects of Zero on Second-Order System
9. Dominant Pole of Second-Order System
10. Characteristics of PM DC Servo Motor
11. Proportional Controller
12. P Controller Used in DC Servo Motor Speed and Position Control
13. Integral Controller
14. I Controller Used in DC Servo Motor Speed and Position Control
15. Derivative Controller
16. D Controller Used in DC Servo Motor Speed and Position Control
17. PI Controller
18. PI Controller Used in DC Servo Motor Speed and Position Control
19. PD Controller
20. PD Controller Used in DC Servo Motor Speed and Position Control
21. PID Controller (I) - Ziegler-nichols Method (1)
22. PID Controller (II) - Ziegler-nichols Method (2)
23. PID Controller (III) - DC Motor Position Control
24. PID Controller (IV) - DC Motor Speed Control
25. PID Controller Used in DC Servo Motor Speed and Position Control
26. Inner-Loop Feedback Control
27. Phase Lead Compensator (I) - Root Locus Method
28. Phase Lead Compensator (II) - Frequency Domain Method
29. Phase Lag Compensator (I) - Root Locus Method
30. Phase Lag Compensator (II) - Frequency Domain Method
31. Phase Lead-lag Compensator (I) - Time Domain Method
32. Phase Lead-lag Compensator (II) - Time Domain Method
33. Phase Lead-lag Compensator (III) - Frequency Domain Method
34. Pole-Zero Cancellation
35. State Feedback / Pole Assignment

Modules / List of Experiments	ACS-13001	ACS-13002	ACS-13003	ACS-13004	ACS-13005	ACS-13006	ACS-13007	ACS-13007A	ACS-13008	ACS-13009	ACS-13010	ACS-13011	ACS-13012	ACS-13013	ACS-13014	ACS-13015	ACS-13016	ACS-13022	ACS-18001
Exp.1 Laplace transform experiment	1	1	1		1	2	1	1			1	1	1				1	1	
Exp.2 System simulation experiment					1	2	1	1			1		1				1	1	
Exp.3 Steady-state error experiment	1					2			1	1	1		1				1	1	
Exp.4 First-order system experiment									1		1		1				1	1	
Exp.5 Second-order system experiment	1								1		1		1				1	1	
Exp.6 Transient response specifications experiment	1								1		1		1				1	1	
Exp.7 Effects of zeros on first-order system experiment										1	1		1				1	1	
Exp.8 Effects of zeros on second-order system experiment	1	1			1	2	1				1		1				1	1	
Exp.9 Dominant pole of second-order system experiment	1					1			1		1		1				1	1	
Exp.10 DC servo motor characteristics experiment												1	1	1		1		1	1
Exp.11 Proportional controller experiment	1	1							1		1		1				1	1	
Exp.12 P controller in DC servo motor speed/position control experiment	1	1									1		1	1	1		1	1	1
Exp.13 Integral controller experiment	1		1						1		1		1				1	1	
Exp.14 I controller in DC servo motor speed/position control experiment	1		1									1	1	1	1		1	1	1
Exp.15 Derivative controller experiment	1			1					1		1		1				1	1	
Exp.16 D controller in DC servo motor speed/position control experiment	1			1							1	1	1	1	1		1	1	1
Exp.17 Proportional-Integral (PI) controller experiment	1	1	1		1				1		1		1				1	1	
Exp.18 PI controller in DC servo motor speed/position control experiment	1	1	1		1							1	1	1	1		1	1	1
Exp.19 Proportional-Derivative (PD) controller experiment	1	1		1	1				1		1		1				1	1	
Exp.20 PD controller in DC servo motor speed / position control experiment	1	1		1	1							1	1	1	1		1	1	1
Exp.21 PID controller (1) Ziegler-nichols method (1)	1	1	1	1	1	1			1		1		1				1	1	
Exp.22 PID controller (2) Ziegler-nichols method (2)	1	1	1	1	1				1	1	1	1	1				1	1	
Exp.23 PID controller (3) Position control	1	1	1	1	1				1		1		1				1	1	
Exp.24 PID controller (4) Speed control	1	1	1	1	1				1			1	1				1	1	
Exp.25 Closed-loop DC servo motor speed/position control with PID controller experiment	1	1	1	1	1							1	1	1			1	1	1
Exp.26 Inner-loop feedback control experiment	1	1		1	1		1		1			1	1	1			1	1	1
Exp.27 Phase lead compensator (1) Root locus technique	1	1							1	1	1		1				1	1	
Exp.28 Phase lead compensator (2) Frequency domain design	1	1							1	1		1	1				1	1	
Exp.29 Phase lag compensator (1) Root locus technique	1	1	1		1				1	1	1		1				1	1	
Exp.30 Phase lag compensator (2) Frequency domain design	1	1	1		1				1	1	1		1				1	1	
Exp.31 Phase lead-lag compensator (1) Root locus technique	1	1			1	1	1		1	1	1		1				1	1	
Exp.32 Phase lead-lag compensator (2) Root locus technique	1	1			1	1	1		1	1	1		1				1	1	
Exp.33 Phase lead-lag compensator (3) Frequency domain design	1	1			1	1	1		1	1	1		1				1	1	
Exp.34 Pole-zero cancellation experiment	1								1	1	1		1				1	1	
Exp.35 State feedback pole assignment experiment					1		1	1	1		1		1	1			1	1	1

1. Optional module : ACS-13022
2. Optional software : MATLAB