

RT300 Series Crane & Hoist Joystick

Product Features

- Single axis or dual axis control;
- Pure silver contacts to ensure durable;
- Spring return to center position or Friction brake;
- Resistant to oil, maritime climate, ozone and UV radiation;
- Support horizontal and vertical contact drive arrangements;
- The energized current up to 380V 10A, with reliable performance;
- CE approved, RoHS 2011/65/EU, Annex II, including (EU) 2015/863 compliant.

Application

RunnTech 300 series industrial crane & hoist joystick (master controller) is mainly used in crane and hoist operations. It is primarily designed for use in circuits with AC 50Hz (60Hz) and rated voltage of 380V or below. And it enables motor operations including reversing, speed regulation, braking, synchronized control and split control. It has been widely adopted across port, maritime systems, railway infrastructure, metallurgy, mining, power facilities, construction equipment and industrial machinery manufacturing sectors.

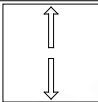
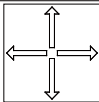
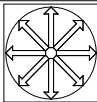


Technical Information

Environment Parameter		
Storage Temperature	-50°C...+80°C	
Operating Temperature	-40°C...+80°C	
Protection Grade	IP64	
Vibration	Amplitude±3g, Frequency: 10Hz-200Hz	
Impact	20g, 6ms, Semi-sinusoidal	
EMC Anti-interference Rank	100V/m, 30MHz to 1GHz, 80% sine-wave modulation, meet EN50082-2 (1995) standard	
EMC Emission Rank	Rank B, 150KHz to 30MHz, meet EN50081-2 (1993) standard	
ESD Anti-interference Rank	Rank 4, 8KV contact discharge, 15KV air discharge, meet IEC61000-4-2 standard	
Mechanical Parameter		
Mechanical Angle	Potentiometer: ±32°, Hall sensor: ±20°	
Operating Torque	5N (50N max)	
Mechanical Life	5 million	
Mechanical Error	± 0.5°	
Electrical Parameter		
Hall Sensor	Power Supply Voltage	5±0.5V DC
	Power Supply Current Consumption	6.5mA/hall sensor

Hall Sensor	Resolution Ratio	infinite
	Maximum Voltage	15VDC
	Reversed Polarity Maximum Voltage	14.5VDC
	Load Resistance	5KΩ
	Median Voltage (no-load)	48 - 52%Vs
Potentiometer	Power Supply Voltage	DC24V
	Power Supply Current	<20mA
	Resolution Ratio	infinite
	Resistance (10%)	5KΩ and 10KΩ
	Electrical Angle	±32°
	Output Voltage Range (relative voltage)	0...100%; 10...90%
	Median Voltage	48%...52%
	Potentiometer Maximum Load Voltage	32VDC
	Maximum Power Consumption (25°C)	0.25W
	Switch Direction	switch position ±3°

Product Configuration

No.	Item	Content	
1	Serial Number	RT300 series crane & hoist joystick controller	
2	Operation Mode	T - spring return TS - spring return + zero interlock M - friction hold MS - friction hold + zero interlock	
3	Limiter Plate	   1 - Y axis 2 - Y/X axis cross direction 3 - Y/X axis full direction	
4	Switch Assembly Type	L : switch assembled Horizontal (default), I : switch assembled Vertical	
5	Electrical Output Form	Hall Sensor	HV1 : DC 5V, 0...2.5...5V (rail to rail)
			HV2 : DC 5V, 0.5...2.5...4.5V
			HV3 : DC 5V, 1.0...2.5...4.0V
			HV4 : DC 5V, 1.25...2.5...3.75V
		Potentiometer	P1 : Simple 2 directions output (potentiometer with dead zone)
			P2 : Simple 1 direction output (potentiometer without dead zone)
			V1 : DC24V, -10V...0...+10V (voltage output)
			V2 : DC24V, +10V...0...+10V (voltage output)
			V3 : DC24V, -5V...0...+5V (voltage output)
			V4 : DC24V, +5V...0...+5V (voltage output)
			V5 : DC24V, 0...+10V (voltage output)
			V6 : DC24V, 0...+5V (voltage output)
			I1 : 4 wire 4mA...12mA...20mA (current output)
			I2 : 4 wire 20mA...4mA...20mA (current output)

6	Potentiometer Type	1K, 2K, 5K, 10K, 20K or H (Hall sensor)
7	Contact Arrangement	Contact Arrangement (Page 10...14) It also can be customized.
8	Handle/Grip Style	HD1, HD2, HD4, HD5, HD7, HD8, HD10, HD15 and HD80 (Page 04...08)
9	Mounting Dimensions	M5: 85×85, central hole 78

RT300 - MS - 2 - L - P1 (10K) - 3(1) - HD39 - M5

①

serial number

②

operation mode

③

limiter plate

④

handle assembly type

⑤

electrical output form

⑥

⑦

⑧

⑨

mounting dimension

handle/grip style

contact arrangement

potentiometer type

Product Installation

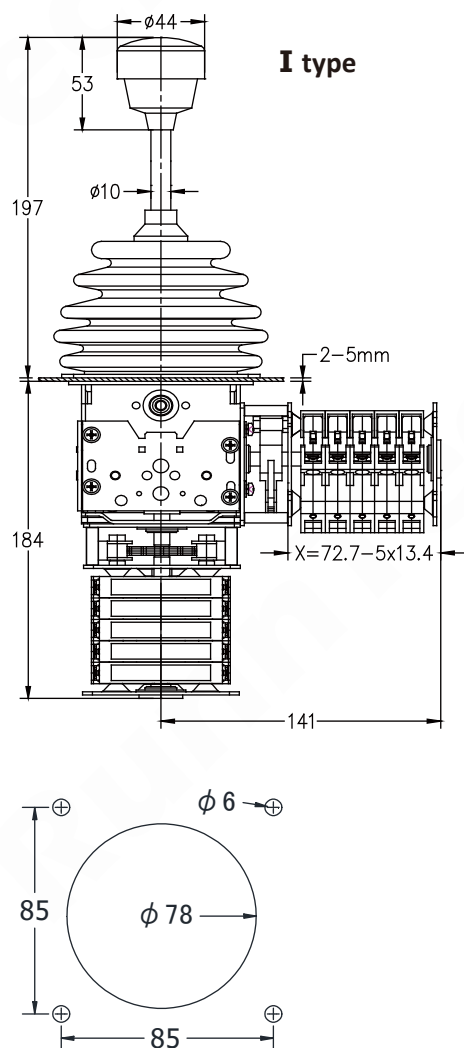
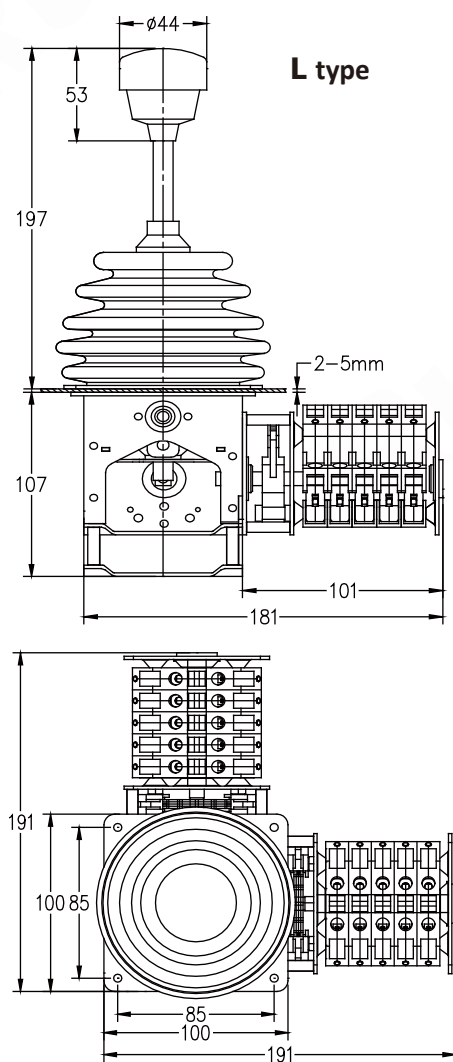
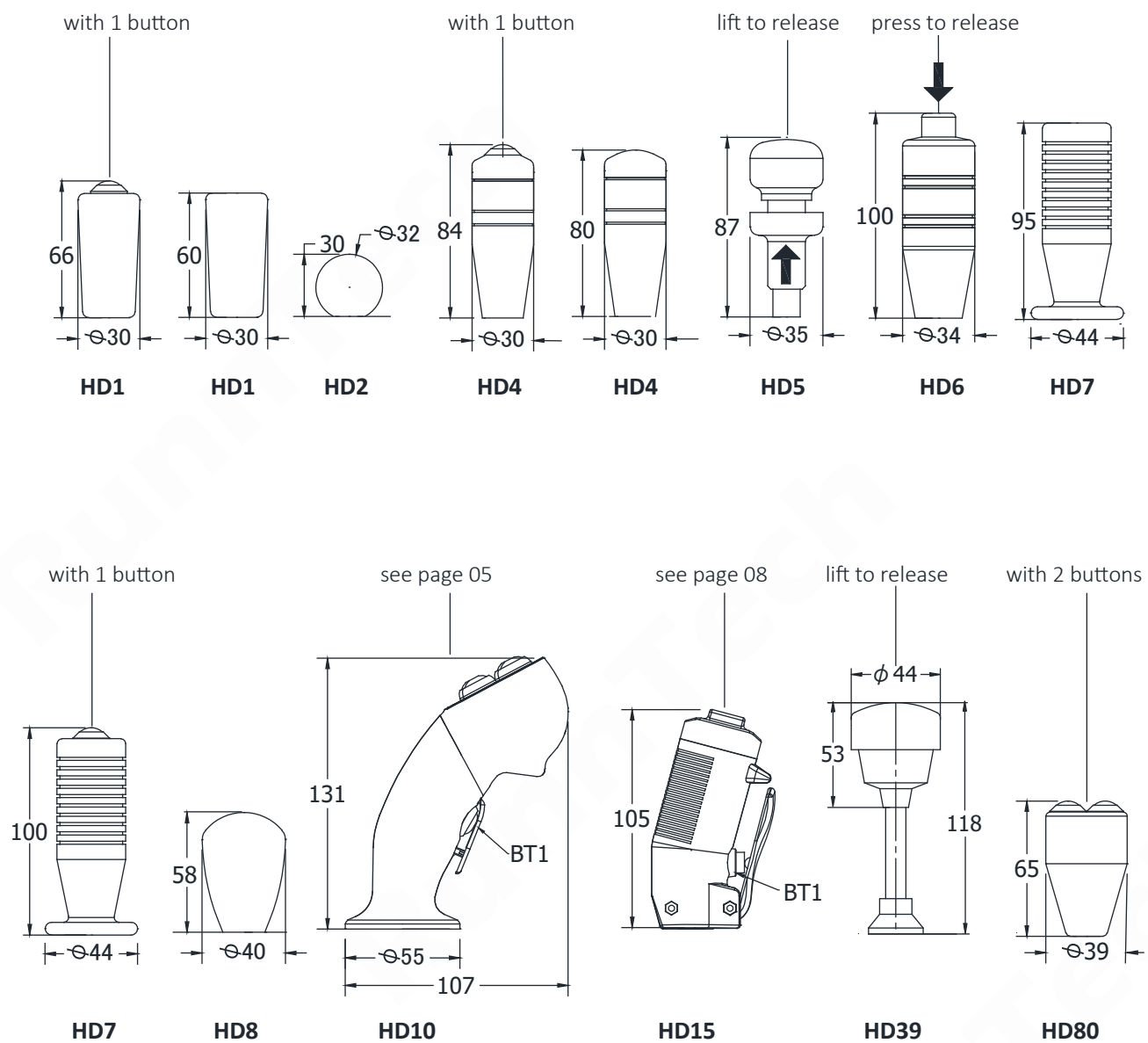


Table 1-1 Handle Grip Style**Remark:**

HD5 grip only available single axis, Spring -return with center-lock (TS-1) or Friction-hold with center-lock (MS-1).

HD6 grip only available single axis, Friction-hold with center-lock (MS-1).

Table 1-5 Handle HD10

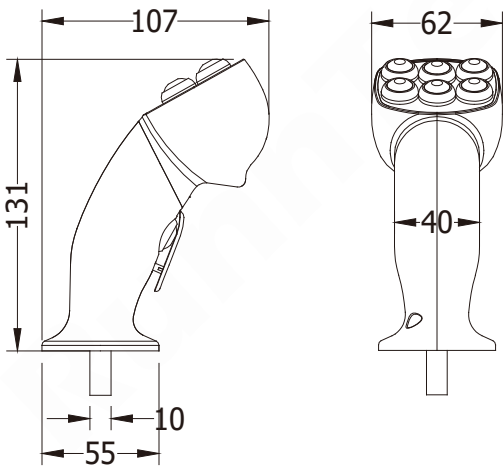
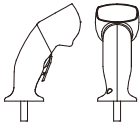
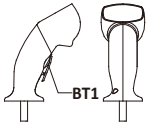
HD10 Handle		
		HD10 handle is ergonomically designed to provide a high degree of comfort, highly integrated, the handle can be installed with a variety of accessories: self-resetting (momentary) push button, self-locking push button, analog thumbwheel controller (W100) or rocker switch (QTOT). We also can customize special technical parameters to meet your requirements. HD10 handle use PA66 + 305GF, to achieve excellent high temperature performance and can be installed in RT100, RT200, RT300 RT01 or RT02 series joysticks to achieve multi-axis control. Operation Temperature: -40-85 ℃ Storage Temperature: -40-85 ℃ Meet IEC68 part 2-20 Protection Grade: IP64/65
		
Model Selection	Style	Description
HD10a		without Deadman trigger
HD10b		with Deadman trigger

Table 1-6 Handle HD10 Panel Layout

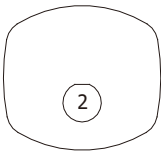
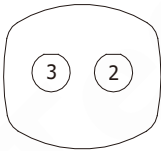
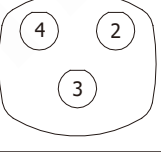
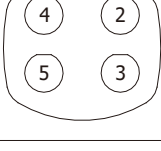
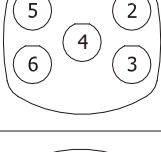
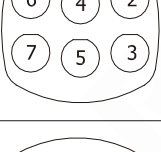
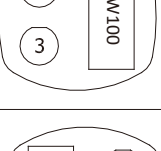
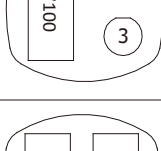
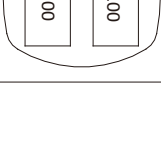
Layout Code	Layout	Description (all functions selection refer to the Table 2-1)
1		1 momentary button (BT) / maintained button (BS)
2		2 momentary button (BT) / maintained button (BS)
3		3 momentary button (BT) / maintained button (BS)
4		4 momentary button (BT) / maintained button (BS)
5		5 momentary button (BT) / maintained button (BS)
6		6 momentary button (BT) / maintained button (BS)
7		1 proportional thumbwheel (W100) and 2 momentary button (BT) / maintained button (BS)
8		1 proportional thumbwheel (W100) and 2 momentary button (BT) / maintained button (BS)
9		2 proportional thumbwheel controller (W100)

Table 1-6 Handle HD10 Panel Layout

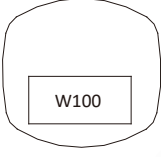
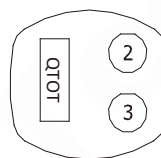
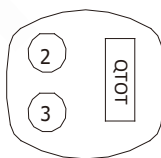
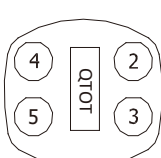
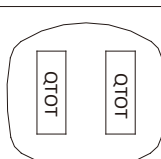
Layout Code	Layout	Description (all functions selection reference Table 2-1)
10		1 proportional thumbwheel controller (W100)
11		1 rocker switch (QTOT) and 2 momentary button (BT) / maintained button (BS)
12		1 rocker switch (QTOT) and 2 momentary button (BT) / maintained button (BS)
13		1 rocker switch (QTOT) and 4 momentary button (BT) / maintained button (BS)
14		2 rocker switch (QTOT)
* we also can customize special panel layout.		
HD10b 13 - BT 4 handle model ——— panel layout code ——— button type (momentary or maintained) ——— button quantity ——— ②③ R ④⑤ G - QTOT 3 positions momentary rocker switch button color button location button selection refer to Table 2-1		

Table 1-8 Handle HD15

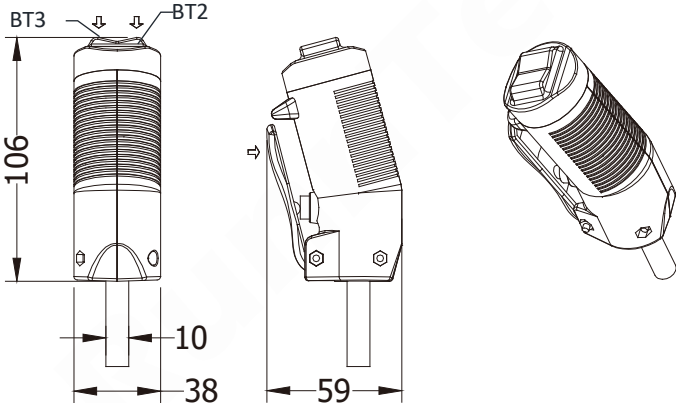
HD15 Handle	
	
HD15 handle is ergonomically designed to provide a high degree of comfort, highly integrated, the handle can be installed with one deadman trigger and rocker switch (QTOT). We also can customize special technical parameters to meet your requirements. HD15 handle use PA66 + 305GF, to achieve excellent high temperature performance and can be installed in RT100 series joysticks to achieve multi-axis control. Operation Temperature: -40-85℃ Storage Temperature: -40-85℃ Meet IEC68 part 2-20 Protection Grade: IP64/65	
	
HD15 - BT1 - QTOT handle model Deadman trigger (250V2A) 3 positions momentary rocker switch (BT2 and BT3)	

Table 2-1 Accessories

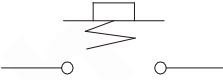
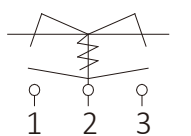
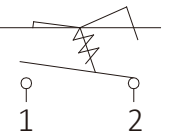
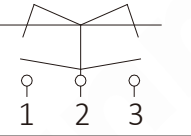
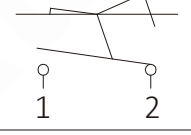
No.	Type	Description	Parameter	Remark
1	BT	momentary button 	24V2A	button color: Red - R Blue - BU Black - BK Yellow - Y Green - G White - W
2	BS	maintained button 	24V2A	button color: Red - R Blue - BU Yellow - Y Green - G
3	QTOT	3 positions momentary rocker switch 	3 pins 250V15A	
4	QTO	2 positions momentary rocker switch 	2 pins 250V15A	
5	QSOS	3 positions maintained rocker switch 	3 pins 250V15A	
6	QSO	2 positions maintained rocker switch 	2 pins 250V15A	
7	QSOT	3 positions, one side momentary another side maintained rocker switch	3 pins 250V15A	
8	W100	proportional thumbwheel (Hall Sensor)	input 5V DC	Please keep far away from the magnetic object

Table 4-1 Contact Arrangement: 1 Step

1(1)				1(2)				1(3)				1(4)				1(5)				1(6)				1(7)				1(8)				1(9)			
	1	0	1		1	0	1		1	0	1		1	0	1		1	0	1		1	0	1		1	0	1		1	0	1				
K1		x		K1		x		K1	x			K1	x			K1	x			K1	x		x	K1	x			K1	x	x					
K2	x			K2			x	K2			x	K2	x			K2	x			K2	x			K2	x			K2	x	x					
K3			x	K3	x			K3			x	K3		x		K3		x		K3		x		K3	x			K3	x						
								K4	x			K4	x			K4		x		K4	x			K4			x	K4		x					
								K5			x	K5			x	K5			x	K5		x		K5		x		K5	x	x					
								K6		x		K6		x		K6			x	K6		x		K6		x		K6		x					

1(10)				1(11)				1(12)				1(13)				1(14)				1(15)				1(16)				1(17)				1(18)			
	1	0	1		1	0	1		1	0	1		1	0	1		1	0	1		1	0	1		1	0	1		1	0	1				
K1			x	K1			x	K1			x	K1			x	K1			x	K1	x			K1	x			K1		x					
K2				K2	x			K2				K2	x			K2	x		x	K2	x	x		K2		x		K2							
K3				K3	x			K3	x			K3			x	K3	x	x		K3	x	x		K3	x			K3		x					
K4			x	K4	x			K4			x	K4				K4			x	K4		x		K4	x			K4	x						
K5				K5				K5	x	x		K5				K5			x	K5				K5			x	K5							
K6	x			K6				K6	x		x	K6	x		x	K6	x			K6				K6	x			K6							
K7	x							K7			x																								
K8	x							K8			x																								
K9	x							K9				x																							
								K10			x																								
								K11	x																										
								K12	x		x																								
								K13			x																								

Table 4-2 Contact Arrangement: 2 Steps

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	2	1	0	1	2																																																																																																																																																																																																																																																																																																																									
K1					x x																																																																																																																																																																																																																																																																																																																									
K2	x	x																																																																																																																																																																																																																																																																																																																												
K3	x				x																																																																																																																																																																																																																																																																																																																									

Table 4-3 Contact Arrangement: 3 Steps

3(1)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x				
K3					x	x	x
K4	x	x				x	x
K5	x						x

3(2)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x		x	x	x
K3	x	x	x				
K4					x	x	x
K5	x	x				x	x
K6	x						x

3(3)							
	3	2	1	0	1	2	3
K1			x	x			
K2	x	x	x				
K3		x					
K4	x	x					
K5	x						
K6	x						
K7				x	x		
K8					x	x	x
K9					x		
K10						x	x
K11							x
K12							x

3(4)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x				
K3					x	x	x
K4			x		x		
K5	x	x				x	x
K6	x						x

3(5)							
	3	2	1	0	1	2	3
K1				x			
K2					x	x	x
K3	x	x	x				
K4	x		x		x		x
K5	x	x				x	x

3(6)							
	3	2	1	0	1	2	3
K1	x	x	x		x	x	x
K2	x	x	x				
K3			x		x		
K4		x				x	
K5	x						x

3(7)							
	3	2	1	0	1	2	3
K1			x				
K2		x					
K3	x						
K4					x		
K5						x	
K6							x

3(8)							
	3	2	1	0	1	2	3
K1				x			
K2				x			
K3							
K4			x		x		
K5		x				x	
K6	x						x

3(9)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x		x	x	x
K3	x	x	x				
K4					x	x	x
K5			x		x		
K6		x				x	
K7	x						x

3(10)							
	3	2	1	0	1	2	3
K1					x	x	x
K2	x	x				x	x
K3		x	x				x

3(11)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x				
K3					x	x	x
K4			x		x		
K5	x	x				x	x
K6	x						x
K7	x	x	x		x	x	x

3(12)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x		x	x	x
K3	x		x		x		x
K4	x	x				x	x

3(13)							
	3	2	1	0	1	2	3
K1				x			
K2					x	x	x
K3	x	x	x				
K4						x	x
K5	x	x					
K6							x
K7	x						

3(14)							
	3	2	1	0	1	2	3
K1					x	x	x
K2	x	x	x				
K3			x		x		
K4		x				x	
K5	x						x

3(15)							
	3	2	1	0	1	2	3
K1				x			
K2					x	x	x
K3	x	x	x				
K4					x	x	x
K5	x	x	x				
K6		x	x	x	x	x	
K7	x	x	x		x	x	x
K8	x						x
K9	x	x				x	x
K10	x						x
K11				x	x	x	
K12	x	x	x				

3(16)							
	3	2	1	0	1	2	3
K1				x			
K2				x			
K3				x			
K4				x			
K5	x	x	x				
K6					x	x	x
K7		x	x	x			
K8	x				x	x	x
K9		x	x				
K10					x	x	x
K11	x						
K12	x				x	x	x
K13	x						x
K14	x						x
K15			x	x	x	x	x
K16		x	x				
K17					x	x	x

3(17)							
	3	2	1	0	1	2	3
K1	x	x	x		x	x	x
K2		x					
K3	x	x	x		x	x	x
K4	x	x	x		x	x	x
K5						x	
K6					x		
K7					x	x	x
K8			x				
K9							x
K10	x						

3(18)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x		x	x	x
K3	x	x	x				
K4	x	x	x				
K5					x	x	x
K6						x	x
K7	x						x
K8	x	x				x	x

3(19)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x				
K3					x	x	x
K4			x				
K5						x	
K6	x	x	x		x	x	x
K7	x	x	x		x	x	x
K8	x	x				x	x
K9	x						x

3(20)							
	3	2	1	0	1	2	3
K1				x			
K2					x	x	x
K3	x	x	x				
K4	x	x				x	x
K5	x		x		x		x

3(21)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x				
K3					x	x	x
K4			x		x		
K5	x					x	
K6	x						x

3(22)							
	3	2	1	0	1	2	3
K1	x	x	x				
K2	x	x					
K3	x						
K4					x	x	x
K5						x	x
K6							x

3(23)							
	3	2	1	0	1	2	3
K1				x			
K2	x	x	x				
K3					x	x	x
K4		x				x	
K5	x						x

3(24)							
	3	2	1	0	1	2	3
K1	x	x	x		x	x	x
K2			x				
K3					x		
K4	x	x				x	x
K5	x						x

3(25)							
	3	2	1	0	1	2	3
K1			x				
K2		x					
K3					x		
K4						x	
K5	x	x					
K6						x	x

Table 4-4 Contact Arrangement: 4 Steps

4(1)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2	x		x	x					
K3						x	x	x	x
K4	x	x	x				x	x	x
K5	x	x						x	x
K6	x								x

4(2)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2	x	x	x	x		x	x	x	x
K3	x	x	x	x					
K4						x	x	x	x
K5	x	x	x				x	x	x
K6	x	x							x
K7	x								x

4(3)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3	x	x	x	x					

4(4)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2	x	x	x	x		x	x	x	x
K3						x	x	x	x
K4	x	x	x	x					

4(5)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2	x	x	x	x					
K3						x	x	x	x

4(6)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3	x	x	x	x					
K4	x	x	x				x	x	x
K5	x	x						x	x
K6	x								x
K7	x	x	x	x	x				

4(7)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3	x	x	x	x					
K4	x	x	x				x		
K5	x	x					x	x	
K6	x								x

4(8)									
	4	3	2	1	0	1	2	3	4
K1				x		x	x	x	x
K2			x			x			x
K3		x					x		x
K4	x							x	x

4(10)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2	x	x						x	x
K3	x	x	x			x	x		
K4	x	x	x	x		x	x	x	x
K5	x	x	x	x	x				
K6				x	x				
K7					x				
K8	x	x						x	x
K9	x				x				x
K10	x	x	x				x	x	x
K11				x	x	x			

4(11)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3	x	x	x	x					
K4				x		x			
K5	x	x	x				x	x	x
K6	x	x						x	x
K7	x								x

4(12)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3	x	x	x	x					
K4						x	x	x	x
K5	x	x	x				x	x	x
K6	x	x						x	x
K7	x								x
K8	x	x	x	x		x	x	x	x

4(13)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x			
K3						x	x	x	x
K4	x	x	x	x					
K5	x	x	x	x		x	x	x	x
K6	x	x	x				x	x	x
K7	x	x						x	x
K8	x								x
K9	x								
K10									x

4(14)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3	x	x	x	x					
K4	x	x	x	x					
K5						x	x	x	x
K6	x	x	x	x		x	x	x	x
K7					x	x	x	x	x
K8	x	x	x	x	x				x
K9					x				
K10	x	x	x				x	x	x
K11			x	x	x	x			
K12	x								x
K13	x	x	x			x	x	x	
K14	x	x	x	x	x	x	x	x	
K15						x	x	x	x
K16	x	x	x	x					
K17					x				

4(15)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3				x	x	x			
K4	x	x							
K5			x						
K6	x	x					x	x	x
K7		x						x	x
K8		x							x
K9	x	x	x			x	x	x	x
K10	x	x	x	x					
K11						x	x	x	x
K12					x				
K13	x	x	x	x	x	x			
K14					x				

4(19)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x	x	x	x
K3	x	x	x	x					
K4	x	x	x	x		x	x	x	x
K5	x	x	x	x					
K6						x	x	x	x
K7			x	x			x	x	
K8						x	x	x	x
K9	x	x	x	x					
K10					x				
K11	x	x	x	x		x	x	x	x
K12	x	x	x	x					
K13						x	x	x	x
K14	x	x	x				x	x	x
K15	x	x						x	x
K16	x								x

4(20)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2	x	x	x	x					
K3						x	x	x	x
K4	x	x	x	x		x	x	x	x
K5						x	x	x	x
K6	x	x	x	x	x				
K7					x				
K8	x	x	x				x	x	x
K9	x	x						x	x
K10	x								x
K11	x	x	x	x		x	x	x	x
K12	x	x	x	x		x	x	x	x

4(21)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x			
K3	x	x	x	x		x	x	x	x
K4						x	x	x	x
K5				x					
K6	x	x	x						
K7					x				
K8					x				
K9						x	x	x	x
K10	x	x	x	x					
K11	x	x	x	x		x	x	x	x
K12	x	x	x	x			x	x	x
K13	x	x	x	x					x
K14	x	x	x						

4(22)									
	4	3	2	1	0	1	2	3	4
K1					x				
K2						x			
K3	x	x	x	x		x	x	x	x
K4	x	x	x	x					
K5	x	x	x	x					
K6						x	x	x	x
K7						x			
K8							x	x	x
K9									x
K10					x				
K11					x				
K12					x				
K13	x								
K14									x
K15	x	x	x	x		x	x	x	x
K16	x	x	x				x	x	x
K17	x	x						x	x

4(23)									
	4	3	2	1	0	1	2	3	4
K1				x		x			
K2			x	x		x	x		
K3		x	x	x		x	x	x	
K4	x	x	x	x		x	x	x	x

Table 4-5 Contact Arrangement: 5 Steps

5(1)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x		x	x	x	x	x
K3							x	x	x	x	x
K4	x	x	x	x	x						
K5	x	x	x	x				x	x	x	x
K6	x	x	x					x	x	x	
K7	x	x								x	x
K8	x										x

5(2)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x						
K3							x	x	x	x	x
K4	x	x	x	x				x	x	x	x
K5	x	x	x						x	x	x
K6	x	x								x	x
K7	x										x

5(3)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x	x	x	x	x
K3	x	x	x	x	x						
K4	x	x	x	x				x	x	x	x
K5	x	x	x						x	x	x
K6	x	x								x	x
K7	x										x

5(4)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x	x	x	x	x
K3	x	x	x	x	x						

5(5)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x		x	x	x	x	x
K3	x	x	x	x				x	x	x	x
K4	x	x	x					x	x	x	
K5	x	x								x	x
K6	x	x	x	x	x						
K7							x	x	x	x	x
K8	x										x
K9			x	x	x		x	x	x		

5(6)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2											
K3	x	x	x	x				x	x	x	x
K4	x	x	x						x	x	x
K5	x	x								x	x
K6	x	x	x	x	x						
K7							x	x	x	x	x
K8	x										x
K9											

5(7)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x				
K3							x	x	x	x	
K4							x	x	x	x	x
K5	x	x						x			x
K6	x						x	x	x		x

5(8)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x						
K3							x	x	x	x	x
K4							x				
K5								x			
K6	x	x							x		x
K7	x	x								x	x

5(9)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x	x	x	x	x
K3	x	x	x	x	x						
K4							x	x	x	x	x
K5	x	x	x	x	x						
K6	x	x	x	x	x		x	x	x	x	x
K7							x	x			
K8							x				
K9	x	x	x	x	x						
K10							x	x	x	x	x
K11	x	x	x	x				x	x	x	x
K12	x	x	x						x	x	
K13	x	x								x	x
K14											x
K15	x										
K16							x				
K17							x				

5(10)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x						
K3							x	x	x	x	x
K4	x	x	x	x	x		x	x	x	x	x
K5	x	x	x	x				x	x	x	x
K6	x	x	x						x	x	x
K7	x	x								x	x
K8	x										x
K9	x	x	x	x	x		x	x	x	x	x

5(11)											
	5	4	3	2	1	0	1	2	3	4	5
K1	x	x	x	x	x		x	x	x	x	x
K2	x	x	x	x	x						
K3	x										x
K4	x	x							x	x	
K5	x		x					x		x	
K6											
K7							x	x			
K8							x				
K9			x						x		
K10	x									x	
K11	x										x
K12							x	x	x	x	x
K13	x	x	x	x	x						

5(12)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x						
K3											
K4	x						x	x	x	x	x
K5								x			
K6	x	x									
K7	x	x									

5(13)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x	x	x	x	x
K3	x	x	x	x	x						
K4							x				
K5	x	x	x	x				x	x	x	x
K6	x	x								x	x
K7	x										x
K8	x	x	x	x	x		x	x	x	x	x
K9	x	x	x							x	x

5(14)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x						
K3							x	x	x	x	x
K4							x				
K5								x			
K6									x		
K7										x	
K8	x										x

5(15)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x	x	x	x	x
K3	x	x	x	x	x						
K4	x	x	x	x				x	x	x	x
K5	x	x	x						x	x	x
K6	x	x								x	x
K7	x										x
K8	x	x	x	x	x		x	x	x	x	x

5(16)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x	x	x	x	x
K3	x	x	x	x	x						
K4	x						x	x			x
K5	x	x	x	x					x	x	x
K6	x	x									x
K7							x				

5(17)											
	5	4	3	2	1	0	1	2	3	4	5
K2	x	x	x					x	x	x	
K3	x	x								x	
K4	x										x
K5	x	x	x	x	x						
K6								x	x	x	x
K7							x				

5(18)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x						
K3							x	x	x	x	x
K4	x	x	x	x	x		x	x	x	x	x
K5	x	x	x	x				x	x	x	x
K6	x	x	x						x	x	x
K7	x	x								x	x
K8	x										x
K9	x										x

5(19)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2							x				
K3								x	x	x	x
K4	x	x	x	x	x						
K5	x	x	x	x					x	x	x
K6	x	x	x							x	x
K7	x	x								x	x
K8	x	x	x	x	x		x	x	x	x	x
K9	x										x

5(20)											
	5	4	3	2	1	0	1	2	3	4	5
K1						x					
K2	x	x	x	x	x						
K3	x										
K4											
K5											

Table 4-6 Contact Arrangement: 6 Steps

6(1)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2							x						
K3								x	x	x	x	x	x
K4	x	x	x	x	x	x							
K5	x	x	x	x	x				x	x	x	x	x
K6	x	x	x	x						x	x	x	x
K7	x	x	x								x	x	x
K8	x	x	x	x	x	x		x	x	x	x	x	x
K9	x	x										x	x
K10	x												x

6(2)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2							x						
K3	x	x	x	x	x	x							
K4								x	x	x	x	x	x
K5	x	x	x	x	x				x	x	x	x	x
K6	x	x	x	x						x	x	x	x
K7	x	x	x								x	x	x
K8	x	x										x	x
K9	x												x

6(3)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2	x	x	x	x	x	x							
K3								x	x	x	x	x	x
K4	x	x	x	x	x				x	x	x	x	x
K5	x	x	x	x							x	x	x
K6	x	x	x									x	x
K7	x	x											x
K8	x												x
K9													

6(4)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1	x	x	x	x	x	x		x	x	x	x	x	x
K2								x	x	x	x	x	x
K3	x	x	x	x	x	x							
K4	x	x	x	x	x				x	x	x	x	x
K5	x	x	x	x						x	x	x	x
K6	x	x	x								x	x	x
K7	x	x										x	x
K8	x												x
K9							x						
K10							x						

6(5)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2								x	x	x	x	x	x
K3	x	x	x	x	x	x							
K4	x	x	x	x	x				x	x	x	x	x
K5	x	x	x	x						x	x	x	x
K6	x	x	x								x	x	x
K7	x	x	x	x	x	x		x	x	x	x	x	x
K8	x	x										x	x
K9	x												x
K10													

6(6)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2								x	x	x	x	x	x
K3	x	x	x	x	x	x							
K4													
K5													
K6													
K7													
K8													
K9													
K10													

6(7)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2	x	x	x	x	x	x		x	x	x	x	x	x
K3								x	x	x	x	x	x
K4	x	x	x	x	x	x							
K5	x	x	x	x	x				x	x	x	x	x
K6	x	x	x	x						x	x	x	x
K7	x	x	x								x	x	x
K8	x	x										x	x
K9	x												x

6(8)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1	x												x
K2	x	x										x	x
K3	x	x	x								x	x	x
K4	x	x	x									x	x
K5	x	x	x	x						x	x	x	x
K6	x	x	x	x	x				x	x	x	x	x
K7	x	x	x	x	x					x	x	x	x
K8	x	x	x	x	x	x		x	x	x	x	x	x
K9	x	x	x	x	x	x							
K10								x	x	x	x	x	x
K11							x						
K12	x	x	x	x	x	x							
K13								x	x	x	x	x	x
K14							x						
K15	x	x	x	x	x	x							
K16								x	x	x	x	x	x

6(9)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2								x					
K3	x	x	x	x	x	x							
K4									x	x	x	x	x
K5	x	x	x	x	x					x	x	x	x
K6	x	x	x	x							x	x	x
K7	x	x	x									x	x
K8	x	x											x
K9	x												x
K10	x	x	x	x	x	x	x	x	x	x	x	x	x

6(10)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2							x		x				
K3	x	x	x	x	x	x		x	x	x	x	x	x
K4	x	x	x	x	x	x							
K5								x	x	x	x	x	x
K6	x	x	x	x	x					x	x	x	x
K7	x	x	x	x						x	x	x	x
K8	x	x	x								x	x	x
K9	x	x										x	x
K10	x												x

6(11)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2							x						
K3	x	x	x	x	x	x							
K4								x	x	x	x	x	x
K5	x	x	x	x	x				x	x	x	x	x
K6	x	x	x	x						x	x	x	x
K7	x	x	x								x	x	x
K8	x	x										x	x
K9	x												x
K10							x						

6(12)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2							x						
K3							x						
K4								x					
K5									x	x	x	x	x
K6		x	x	x	x	x							
K7		x	x	x	x	x		x	x	x	x	x	x
K8		x	x	x	x	x			x	x	x	x	x
K9			x	x	x					x	x	x	
K10				x	x						x	x	
K11					x							x	
K12													
K13													
K14													
K15													
K16													
K17													
K18													
K19													
K20													

6(13)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1								x	x	x	x	x	x
K2	x	x	x	x	x	x							
K3							x		x				
K4										x			
K5					x						x		
K6				x								x	
K7			x										x
K8			x										x
K9													
K10													

6(14)													
	6	5	4	3	2	1	0	1	2	3	4	5	6
K1							x						
K2	x	x	x	x	x	x							
K3								x	x	x	x	x	x
K4	x	x				x	x		x	x		x	x
K5		x	x	x	x				x	x	x	x	x
K6	x	x	x								x	x	x

6(15)													
	6	5	4	3									