

RCS-2 RIO INTERFACE PROGRAMMER'S MANUAL



IMPORTANT: Before using this equipment, carefully read **SAFETY PRECAUTIONS**, starting on page 1, and all instructions in this manual. Keep this Service Manual for future reference.

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Section 1: SAFETY

Before operating, maintaining or servicing any ITW Ransburg electrostatic coating system, read and understand all of the technical and safety literature for your ITW Ransburg products. This manual contains information that is important for you to know and understand.

This information relates to USER SAFETY and PREVENTING EQUIPMENT PROBLEMS. To help you recognize this information, we use the following symbols:



CAUTION - states information that tells how to prevent damage to equipment or how to avoid a situation that might cause minor injury.



WARNING - states information to alert you to a situation that might cause serious injury if instructions are not followed.

While this manual lists standard specifications and service procedures, some minor deviations may be found between the literature and your equipment. Differences in local codes and plant requirements, material delivery requirements, etc., make such variations inevitable. Compare this manual with your system installation drawings and appropriate ITW Ransburg equipment manuals to reconcile such differences.



Careful study and continued use of this manual will provide a better understanding of the equipment and process, resulting in more efficient operation, longer trouble-free service and faster, easier troubleshooting. If you do not have the manuals and safety literature for your Ransburg system, contact your local ITW Ransburg representative or ITW Ransburg.






WARNING

- The user **MUST** read and be familiar with the Safety Section in this manual and the ITW Ransburg safety literature therein identified.
- This manual **MUST** be read and thoroughly understood by **ALL** personnel who operate, clean or maintain this equipment! Special care should be taken to ensure that the WARNINGS and safety requirements for operating and servicing the equipment are followed. The user should be aware of and adhere to **ALL** local building and fire codes and ordinances as well as NFPA 33 SAFETY STANDARD, 2009 EDITION, prior to installing, operating, and/or servicing this equipment.
- The hazards shown on the following pages may occur during normal use of this equipment. Please read the hazard chart beginning on page 6.

AREA	HAZARD	SAFEGUARDS
<p>Spray Area</p> 	<p>Fire Hazard</p> <p>Improper or inadequate operation and maintenance procedures will cause a fire hazard.</p> <p>Protection against inadvertent arcing that is capable of causing fire or explosion is lost if any safety interlocks are disabled during operation. Frequent power supply shut-down indicates a problem in the system requiring correction.</p>	<p>Follow These Guidelines</p> <p>Fire extinguishing equipment must be present in the spray area and test periodically.</p> <p>Spray areas must be kept clean to prevent the accumulation of combustible residues.</p> <p>Smoking must never be allowed in the spray area.</p> <p>The high voltage supplied to the atomizer must be turned off prior to cleaning, flushing or maintenance.</p> <p>When using solvents for cleaning:</p> <ul style="list-style-type: none"> • Those used for equipment flushing should have flash points equal to or higher than those of the coating material. • Those used for general cleaning must have flash points above 1000F (37.80C). <p>Spray booth ventilation must be kept at the rates required by NFPA 33, 2009 Edition, OSHA and local codes. Ventilation must be maintained during cleaning operations using flammable or combustible solvents.</p> <p>Electrostatic arcing must be prevented.</p> <p>Non-factory replacement parts or unauthorized equipment modifications may cause fire or injury.</p> <p>If used, a key switch bypass is intended for use only during setup operations. Production should never be done with safety interlocks disabled.</p> <p>Never use equipment for use in waterborne installations to spray solvent based materials.</p>

AREA	HAZARD	SAFEGUARDS
<p>Spray Area</p> 	<p>Explosion</p> <p>Improper or inadequate operation and maintenance procedures may cause an explosion.</p> <p>Protection against inadvertent arcing that is capable of causing fire or explosion is lost if any safety interlocks are disabled during operation. Frequent power supply shutdown indicates a problem in the system requiring correction.</p>	<p>Follow These Guidelines</p> <p>Electrostatic arcing MUST be prevented.</p> <p>All electrical equipment must be located outside Class I or II, Division 1 or 2 hazardous areas, in accordance with NFPA 33, 2009 Edition.</p> <p>Test only in areas free of flammable or combustible materials.</p> <p>The current overload sensitivity (if equipped) MUST be set as described in corresponding section of the equipment manual. Protection against inadvertent arcing that is capable of causing fire or explosion is lost if the current overload sensitivity is not properly set. Frequent power shutdown indicates a problem with the system which requires correction.</p> <p>Always turn the control panel off prior to flushing, cleaning, or working on spray system equipment.</p> <p>Ensure that the control panel is interlocked with the ventilation system and conveyor in accordance with NFPA 33, 2009 Edition.</p> <p>Have fire extinguishing equipment readily available and tested periodically.</p>
<p>Spray Area</p> 	<p>Explosion - Incompatible Materials</p> <p>Halogenated hydrocarbon solvents for example: methylene chloride and 1,1,1,-Trichloroethane are not chemically compatible with the aluminum that might be used in many system components. The chemical reaction caused by these solvents reacting with aluminum can become violent and lead to an equipment explosion.</p>	<p>Follow These Guidelines</p> <p>Aluminum is widely used in other spray application equipment - such as material pumps, regulators, triggering valves, etc. Halogenated hydrocarbon solvents must never be used with aluminum equipment during spraying, flushing, or cleaning. Read the label or data sheet for the material you intend to spray. If in doubt as to whether or not a coating or cleaning material is compatible, contact your coating supplier. Any other type of solvent may be used with aluminum equipment.</p>

AREA	HAZARD	SAFEGUARDS
<p>Spray Area / High Voltage Equipment</p> 	<p>Electrical Discharge</p> <p>There is a high voltage device that can induce an electrical charge on ungrounded objects which is capable of igniting coating materials.</p> <p>Inadequate grounding will cause a spark hazard. A spark can ignite many coating materials and cause a fire or explosion.</p>	<p>Follow These Guidelines</p> <p>Parts being sprayed must be supported on conveyors or hangers and be grounded. The resistance between the part and ground must not exceed 1 mega ohm.</p> <p>All electrically conductive objects in the spray area, with the exception of those objects required by the process to be at high voltage, must be grounded.</p> <p>Any person working in the spray area must be grounded.</p> <p>Unless specifically approved for use in hazardous locations, the power supply and other electrical control equipment must NOT be used in Class I, Division 1 or 2 locations.</p>
<p>Electrical Equipment</p> 	<p>Electrical Discharge</p> <p>High voltage equipment is utilized. Arcing in areas of flammable or combustible materials may occur. Personnel are exposed to high voltage during operation and maintenance.</p> <p>Protection against inadvertent arcing that may cause a fire or explosion is lost if safety circuits are disabled during operation.</p> <p>Frequent power supply shutdown indicates a problem in the system which requires correction.</p> <p>An electrical arc can ignite coating materials and cause a fire or explosion.</p>	<p>Follow These Guidelines</p> <p>All electrical equipment must be located outside Class I or II, Division 1 or 2 hazardous areas. Refer to NFPA 33, 2009 Edition.</p> <p>Turn the power supply OFF before working on the equipment.</p> <p>Test only in areas free of flammable or combustible material.</p> <p>Testing may require high voltage to be on, but only as instructed.</p> <p>Production should never be done with the safety circuits disabled.</p> <p>Before turning the high voltage on, make sure no objects are within the sparking distance.</p>

AREA	HAZARD	SAFEGUARDS
<p>Toxic Substances</p> 	<p>Mechanical Hazard</p> <p>Certain material may be harmful if inhaled, or if there is contact with the skin.</p>	<p>Follow These Guidelines</p> <p>Follow the requirements of the Material Safety Data Sheet supplied by the coating manufacturer.</p> <p>Adequate exhaust must be provided to keep the air free of accumulations of toxic materials.</p> <p>Use a mask or respirator whenever there is a chance of inhaling sprayed materials. The mask must be compatible with the material being sprayed and its concentration. Equipment must be as prescribed by an industrial hygienist or safety expert, and be NIOSH approved.</p>
<p>Robot Work Area</p>	<p>Mechanical Hazard</p> <p>Improper use or maintenance can lead to hazardous conditions, particularly from unexpected robot manipulator movement.</p>	<p>Follow These Guidelines</p> <p>Applicator adjustments or maintenance should be done after the robot is taken out of service. Do not adjust or repair the applicator if the robot is operating or standing ready to start.</p> <p>Refer to robot operating instructions for the procedures to take a robot out of service.</p> <p>Follow all OSHA Lockout / Tagout procedures when performing any maintenance.</p>
<p>All Areas</p>	<p>Improper / Inadequate Training</p> <p>Improper operation or maintenance may create a hazard.</p> <p>Personnel must be properly trained in the use of this equipment.</p>	<p>Follow These Guidelines</p> <p>Personnel must be given training in accordance with the requirements of NFPA 33, 2009 Edition.</p> <p>Instructions and safety precautions must understood prior to using this equipment.</p> <p>Comply with appropriate codes governing ventilation, fire protection, operation maintenance, and housekeeping. OSHA references are sections 1910.94 and 1910.107. Also refer to NFPA 33, 2009 Edition and your insurance company requirements.</p>

Section 2: INTRODUCTION

The RCS-2 System is capable of communicating with Allen Bradley (Rockwell Automation) style PLC's using Remote I/O via the optional RIO Interface Card (P/N: 77377-22). Some of the data to and from the RCS-2 may be in the form of simple bits (Discrete I/O) or in the form of tables of data (Block Transfer Reads or Writes).

Section 3: HARDWARE SETUP

The RCS-2 system uses two-slot addressing. Slot 0 is reserved for handshaking bits to support RIO Block Transfers.

The RCS-2 Interface Module appears as a single 8-bit I/O module in slot 1. Therefore, the RCS-2 Interface Module, which reports the System I/O signals, use the high byte (bits 8 through 15) of word 0.

Each RCS-2 Channel Card appears as two 14-bit I/O modules (two slots). Each of four possible RCS-2 Channel Cards supports two channels for a total of 8 channels. Channel 1 through 7 use bits 0 through 13 of RIO words 1 through 7. Channel 8 uses bits 14 and 15 of RIO words 1 through 7.

Section 4: RIO RACK ADDRESS

The RIO Rack Address is used to indicate to which RIO rack the Interface Module is assigned. RIO Rack Addresses are specified in octal format. There are 64 (decimal) possible Rack Addresses, which are assigned 00 through 77 (octal).

RIO RACK ADDRESS						
SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6	RIO Rack Address (Octal)
OFF	OFF	OFF	OFF	OFF	OFF	0
OFF	OFF	OFF	OFF	OFF	ON	1
OFF	OFF	OFF	OFF	ON	OFF	2
OFF	OFF	OFF	OFF	ON	ON	3
OFF	OFF	OFF	ON	OFF	OFF	4
OFF	OFF	OFF	ON	OFF	ON	5
OFF	OFF	OFF	ON	ON	OFF	6
OFF	OFF	OFF	ON	ON	ON	7
OFF	OFF	ON	OFF	OFF	OFF	10
OFF	OFF	ON	OFF	OFF	ON	11
OFF	OFF	ON	OFF	ON	OFF	12

RIO RACK ADDRESS (continued)

RIO RACK ADDRESS						
SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6	RIO Rack Address (Octal)
OFF	OFF	ON	OFF	ON	ON	13
OFF	OFF	ON	ON	OFF	OFF	14
OFF	OFF	ON	ON	OFF	ON	15
OFF	OFF	ON	ON	ON	OFF	16
OFF	OFF	ON	ON	ON	ON	17
OFF	ON	OFF	OFF	OFF	OFF	20
OFF	ON	OFF	OFF	OFF	ON	21
OFF	ON	OFF	OFF	ON	OFF	22
OFF	ON	OFF	OFF	ON	ON	23
OFF	ON	OFF	ON	OFF	OFF	24
OFF	ON	OFF	ON	OFF	ON	25
OFF	ON	OFF	ON	ON	OFF	26
OFF	ON	OFF	ON	ON	ON	27
OFF	ON	ON	OFF	OFF	OFF	30
OFF	ON	ON	OFF	OFF	ON	31
OFF	ON	ON	OFF	ON	OFF	32
OFF	ON	ON	OFF	ON	ON	33
OFF	ON	ON	ON	OFF	OFF	34
OFF	ON	ON	ON	OFF	ON	35
OFF	ON	ON	ON	ON	OFF	36
OFF	ON	ON	ON	ON	ON	37
ON	OFF	OFF	OFF	OFF	OFF	40
ON	OFF	OFF	OFF	OFF	ON	41
ON	OFF	OFF	OFF	ON	OFF	42
ON	OFF	OFF	OFF	ON	ON	43
ON	OFF	OFF	ON	OFF	OFF	44
ON	OFF	OFF	ON	OFF	ON	45
ON	OFF	OFF	ON	ON	OFF	46
ON	OFF	OFF	ON	ON	ON	47
ON	OFF	ON	OFF	OFF	OFF	50

RIO RACK ADDRESS (continued)

RIO RACK ADDRESS						
SW1-1	SW1-2	SW1-3	SW1-4	SW1-5	SW1-6	RIO Rack Address (Octal)
ON	OFF	ON	OFF	OFF	ON	51
ON	OFF	ON	OFF	ON	OFF	52
ON	OFF	ON	OFF	ON	ON	53
ON	OFF	ON	ON	OFF	OFF	54
ON	OFF	ON	ON	OFF	ON	55
ON	OFF	ON	ON	ON	OFF	56
ON	OFF	ON	ON	ON	ON	57
ON	ON	OFF	OFF	OFF	OFF	60
ON	ON	OFF	OFF	OFF	ON	61
ON	ON	OFF	OFF	ON	OFF	62
ON	ON	OFF	OFF	ON	ON	63
ON	ON	OFF	ON	OFF	OFF	64
ON	ON	OFF	ON	OFF	ON	65
ON	ON	OFF	ON	ON	OFF	66
ON	ON	OFF	ON	ON	ON	67
ON	ON	ON	OFF	OFF	OFF	70
ON	ON	ON	OFF	OFF	ON	71
ON	ON	ON	OFF	ON	OFF	72
ON	ON	ON	OFF	ON	ON	73
ON	ON	ON	ON	OFF	OFF	74
ON	ON	ON	ON	OFF	ON	75
ON	ON	ON	ON	ON	OFF	76
ON	ON	ON	ON	ON	ON	77

Section 5: RIO RACK INFORMATION

RIO RACK SIZE

The RIO Rack size must be specified to allow the RIO Interface Card to communicate over the RIO link. ***When used with the RCS-2, the only valid Rack Size is a Full Rack.*** Therefore, always set switches SW2-7 and SW2-8 to the ON position. These switch settings allow 8 discrete I/O words and the ability to use from 1 to 4 RCS-2 Channel Cards.

RIO STARTING QUARTER

The RIO Starting Quarter within the rack must be specified to allow the RIO Interface Card to communicate over the RIO link. ***When used with the RCS-2, the only valid RIO Starting Quarter is 0, since the RIO Rack Size is a Full Rack.*** Therefore, always set switches SW1-7 and SW1-8 to the OFF position.

RIO BAUD RATE, MAXIMUM CABLE LENGTH, AND BUS TERMINATION

The RIO Baud Rate must be specified to allow the RIO Interface Card to communicate over the RIO link. The RIO Baud Rate is specified with SW2, positions 3 and 4. If the RCS-2 RIO Interface Card is at the end of the RIO Link, a terminating resistor must be installed.

SW2-3	SW2-4	RIO Baud Rate	Max. Cable Length	RIO Bus Terminator
OFF	OFF	57.6 Kbaud	3,048 m (10,000 ft)	150 Ohm (see note), 1/8 Watt
OFF	ON	115.2 Kbaud	1,524 m (5,000 ft)	150 Ohm (see note), 1/8 Watt
ON	OFF	230.4 Kbaud	762 m (2,500 ft)	82 Ohm, 1/8 Watt
ON	ON	230.4 Kbaud	762 m (2,500 ft)	82 Ohm, 1/8 Watt

Note: Use an 82 Ohm resistor, unless the RIO master device requires 150 Ohm. The terminating resistor is required at both ends of the RIO Link.

Recommendation: Always run the baud rate at the maximum rate possible. ITW recommends always using 230.4 Kbaud unless it is necessary to operate at a lower speed because of environmental issues (noise, cable lengths, etc.). Since reasonably large blocks of data are transferred in several of the block transfers and since RIO is not a deterministic network, the amount of time it takes for the data to be returned to the PLC from the RCS-2 controller may be significant and is unpredictable. When requesting data from the RCS-2, always wait for the RIO transmission complete bit to be set and verify that there were no errors by checking the RIO error bit prior to using returned data.

UNUSED SWITCHES

When the 77377-22 RIO Interface Card is used in an RCS-2 rack, switches SW2-1, SW2-2, SW2-5, and SW2-6 are unused and should be left in the OFF position.

Section 6: DISCRETE I/O

DISCRETE I/O

There are eight (8) 16-bit words used for digital (discrete) inputs and outputs via RIO in the RCS-2.

Word 0 is for System inputs and outputs.

Words 1 through 7 are for Channel 1 through 7 inputs and outputs with each channel having 14 possible inputs and outputs. The Channel 8 inputs and outputs are distributed across words 1 through 7 as bits 14 and 15 of these words. When a gun is configured with two channels, the odd channel, and thus odd word, is the controlling channel for the gun.

The RCS-2 also has hard-wired discrete I/O capabilities and input bits received by the RCS-2 via RIO are logical ORed with these discrete signals prior to being processed by the software. Likewise, any output bits are sent both to the PLC via RIO and the hard-wired discrete outputs.

Note: The speed with which the RCS-2 responds to discrete inputs and output via the RIO link is very fast and should approach the speed of communicating with it via its physical discrete inputs and outputs. In most circumstances where a pulse is required to set the RCS-2 in a desired mode, holding the signal on for 0.25 seconds is adequate. However, there have been instances where that time has not been adequate (when the RCS-2 was on a busy RIO channel). Some experimentation may be necessary to insure that the unit does in fact react predictably and repeatedly to the commands issued. Many of the discrete input commands can be confirmed by monitoring the feedback signals from the RCS-2. (Refer to Appendix A for a list of discrete inputs and outputs, their functions, and how they affect other inputs or outputs.)

For signals that cannot tolerate any delay whatsoever (such as gun trigger and analog flow command) it is imperative that these signals be wired directly to the physical discrete inputs of the RCS and not run via RIO.

DISCRETE SYSTEM I/O

Bit #	PLC Inputs	PLC Outputs	PLC Word 0
0	n/a	n/a	n/a
1	n/a	n/a	n/a
2	n/a	n/a	n/a
3	n/a	n/a	n/a
4	n/a	n/a	n/a
5	n/a	n/a	n/a
6	n/a	n/a	n/a
7	n/a	n/a	n/a
8	System Faulted	Spare Digital In	System
9	System Pulse	Spare Digital In	System
10	User Link Active	Spare Digital In	System
11	Spare Digital Out	Spare Digital In	System
12	Spare Digital Out	Spare Digital In	System

DISCRETE I/O (continued)

Bit #	PLC Inputs	PLC Outputs	PLC Word 0
13	RCS2 BTR Data Ready	Spare Digital In	System
14	RCS2 BTW Clear To Send	Spare Digital In	System
15	RCS2 RIO Error	Spare Digital In	System

Note: The status of the System I/O bits can be monitored with the RCS-2 user-interface software. Open the fms.exe software, select function F7 (Dig/Ana I/O), then select System I/O. If the RCS-2 user-interface software sees one of its System I/O bits turned on or off via RIO, there will be a (R) indicator after the ON or OFF indicator in the appropriate box. This indicates that the input is being controlled by RIO.

DISCRETE CHANNEL / GUN I/O

Bit #	PLC Inputs	PLC Outputs	PLC Words 1 to 7						
			1	2	3	4	5	6	7
0	Fault	Fast Fill	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
1	Ready	Channel Fill	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
2	Spray Shutdown	Feather Set	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
3	Flush Request	Run	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
4	Motor On	Halt/Fault Reset	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
5	Motor Amp Re-set	Trigger 1	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
6	Spare Digital Out	Reserved	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
7	Spare Digital Out	Trigger 2	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
8	Spare Digital Out	Trigger 3	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
9	Spare Digital Out	Trigger 4	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
10	Spare Digital Out	Volume Fill	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
11	Spare Digital Out	Push Out	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7

DISCRETE CHANNEL / GUN I/O (continued)

Bit #	PLC Inputs	PLC Outputs	PLC Words 1 to 7						
			1	2	3	4	5	6	7
12	Spare Digital Out	Spare Digital In	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
13	Spare Digital Out	Spare Digital In	Ch. 1	Ch. 2	Ch. 3	Ch. 4	Ch. 5	Ch. 6	Ch. 7
14	n/a	n/a	Ch. 8 Bit 0	Ch. 8 Bit 2	Ch. 8 Bit 4	Re-served	Ch. 8 Bit 8	Ch. 8 Bit 10	Ch. 8 Bit 12
15	n/a	n/a	Ch. 8 Bit 1	Ch. 8 Bit 3	Ch. 8 Bit 5	Ch. 8 Bit 7	Ch. 8 Bit 9	Ch. 8 Bit 11	Ch. 8 Bit 13

The Channel (Gun) 8 discrete I/O bits are distributed across PLC words 1 through 7 in bits 14 and 15 as shown above.

Note: The status of the Channel/Gun I/O bits can be monitored with the RCS-2 user-interface software. Open the fms.exe software, select function F7 (Dig/Ana I/O), then select Gun I/O. If the RCS-2 user-interface software sees one of its Gun I/O bits turned on or off via RIO, there will be a (R) indicator after the ON or OFF indicator in the appropriate box. This indicates that the input is being controlled by RIO.

Section 7: BLOCK TRANSFER DATA

It is highly recommended that any time a change is to be made to a parameter in the RCS-2 via this RIO link it be done in a Read-Modify-Write fashion. That is, it is not possible to send just one parameter at a time (say for instance, the ratio) and change just that parameter. There are 10 different block transfer types and the amount of data varies from 4 words to 60 words depending on what parameters are to be read or written. Data is not filtered by the RIO card so if invalid data (data outside acceptable limits) is sent to the RCS-2 via RIO it will most likely generate a fault (typically a channel card parameter fault) and the system will shut down. If this occurs, it is necessary to correct the corrupt data prior to restarting the system. This can be done by correcting the offending data or reloading a known good parameter set.

BLOCK TRANSFER TYPES

RIO Block Transfer Types			
Type	Description	BTR Length	BTR Length
0	Null Data	4	4
1	Gun Operational Status	52	20
2	Channel Operational Status	60	N/A
3	System Configuration	29	29
4	Gun Configuration	25	25
5	Channel Configuration	30	30

BLOCK TRANSFER DATA (continued)

RIO Block Transfer Types			
Type	Description	BTR Length	BTW Length
6	Job Configuration	41	41
7	Flow Totals	26	5
8	Error Log	54	5
9	Alarm Configuration	6	6

NULL DATA - TYPE 00

A BTW must always precede a BTR in order to inform the RCS-2 Interface Module what data is to be returned in the next BTR. Null BTW commands can be used when no data is required prior to the next BTR. If the next BTR Type does not require a Gun Number or a Channel Number and/or Job Number, those fields may be zero. Otherwise, the Next BTR Type, Gun Number, Channel Number and Job Number specify the appropriate data to be returned in the next BTR.

Null – Type 00				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	0
1	BTR Type	0	Next BTR Type	00 to 09
2	N/A	N/A	Next BTR Gun #	1 to 8 or N/A
3	N/A	N/A	Next BTR Job #	1 to 199 or N/A

GUN OPERATIONAL STATUS - TYPE 01

The Gun Operational Status Block transfers are used for normal process control while painting parts. This assumes the system and applicators have been initially configured.

The gun numbers, job numbers, and setpoints may be specified as 0 if not change is desired for a gun. However, if a setpoint is specified as non-zero, a valid job number must be specified.

Gun Operational Status – Type 01				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	1
1	BTR Type	1	Next BTR Type	00 to 09

BLOCK TRANSFER DATA (continued)

Gun Operational Status – Type 01				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
2	N/A	N/A	Next BTR Gun/ Chan. #	1 to 8 or N/A
3	N/A	N/A	Next BTR Job #	1 to 199 or N/A
4	Current Running Job # for Gun #1	1 to 199	Gun #1 Job #	0 to 199
5	Current Running Job # for Gun #2	1 to 199	Gun #1 Set Point	cc/min x 10
6	Current Running Job # for Gun #3	1 to 199	Gun #2 Job #	0 to 199
7	Current Running Job # for Gun #4	1 to 199	Gun #2 Set Point	cc/min x 10
8	Current Running Job # for Gun #5	1 to 199	Gun #3 Job #	0 to 199
9	Current Running Job # for Gun #6	1 to 199	Gun #3 Set Point	cc/min x 10
10	Current Running Job # for Gun #7	1 to 199	Gun #4 Job #	0 to 199
11	Current Running Job # for Gun #8	1 to 199	Gun #4 Set Point	cc/min x 10
12	Gun #1 Actual Ratio	Ratio x 100	Gun #5 Job #	0 to 199
13	Gun #2 Actual Ratio	Ratio x 100	Gun #5 Set Point	cc/min x 10
14	Gun #3 Actual Ratio	Ratio x 100	Gun #6 Job #	0 to 199
15	Gun #4 Actual Ratio	Ratio x 100	Gun #6 Set Point	cc/min x 10
16	Gun #5 Actual Ratio	Ratio x 100	Gun #7 Job #	0 to 199
17	Gun #6 Actual Ratio	Ratio x 100	Gun #7 Set Point	cc/min x 10
18	Gun #7 Actual Ratio	Ratio x 100	Gun #8 Job #	0 to 199
19	Gun #8 Actual Ratio	Ratio x 100	Gun #8 Set Point	cc/min x 10
20	Gun #1 Target Flow	cc/min x 10		
21	Gun #2 Target Flow	cc/min x 10		
22	Gun #3 Target Flow	cc/min x 10		
23	Gun #4 Target Flow	cc/min x 10		
24	Gun #5 Target Flow	cc/min x 10		
25	Gun #6 Target Flow	cc/min x 10		
26	Gun #7 Target Flow	cc/min x 10		

BLOCK TRANSFER DATA (continued)

Gun Operational Status – Type 01				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
27	Gun #8 Target Flow	cc/min x 10		
28	Gun #1 Actual Flow	cc/min x 10		
29	Gun #2 Actual Flow	cc/min x 10		
30	Gun #3 Actual Flow	cc/min x 10		
31	Gun #4 Actual Flow	cc/min x 10		
32	Gun #5 Actual Flow	cc/min x 10		
33	Gun #6 Actual Flow	cc/min x 10		
34	Gun #7 Actual Flow	cc/min x 10		
35	Gun #8 Actual Flow	cc/min x 10		
36	Gun #1, Hardener Flow	0 to 1023		
37	Gun #2, Hardener Flow	0 to 1023		
38	Gun #3, Hardener Flow	0 to 1023		
39	Gun #4, Hardener Flow	0 to 1023		
40	Gun #5, Hardener Flow	0 to 1023		
41	Gun #6, Hardener Flow	0 to 1023		
42	Gun #7, Hardener Flow	0 to 1023		
43	Gun #8, Hardener Flow	0 to 1023		
44	Gun #1, Feather Pressure	PSIG		
45	Gun #2, Feather Pressure	PSIG		
46	Gun #3, Feather Pressure	PSIG		
47	Gun #4, Feather Pressure	PSIG		
48	Gun #5, Feather Pressure	PSIG		
49	Gun #6, Feather Pressure	PSIG		
50	Gun #7, Feather Pressure	PSIG		
51	Gun #8, Feather Pressure	PSIG		

CHANNEL OPERATIONAL STATUS - TYPE 02

Channel Operational Status – Type 02				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	N/A
1	BTR Type	2	Next BTR Type	N/A
2	N/A	N/A	Next BTR Gun/ Chan. #	N/A
3	N/A	N/A	Next BTR Job #	N/A

BLOCK TRANSFER DATA (continued)

Channel Operational Status – Type 02				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
4	Target Flow Rate, Chan. 1	cc/min x 10		
5	Target Flow Rate, Chan. 2	cc/min x 10		
6	Target Flow Rate, Chan. 3	cc/min x 10		
7	Target Flow Rate, Chan. 4	cc/min x 10		
8	Target Flow Rate, Chan. 5	cc/min x 10		
9	Target Flow Rate, Chan. 6	cc/min x 10		
10	Target Flow Rate, Chan. 7	cc/min x 10		
11	Target Flow Rate, Chan. 8	cc/min x 10		
12	Actual Flow Rate, Chan. 1	cc/min x 10		
13	Actual Flow Rate, Chan. 2	cc/min x 10		
14	Actual Flow Rate, Chan. 3	cc/min x 10		
15	Actual Flow Rate, Chan. 4	cc/min x 10		
16	Actual Flow Rate, Chan. 5	cc/min x 10		
17	Actual Flow Rate, Chan. 6	cc/min x 10		
18	Actual Flow Rate, Chan. 7	cc/min x 10		
19	Actual Flow Rate, Chan. 8	cc/min x 10		
20	Pump Inlet Pressure, Chan. 1	PSIG		
21	Pump Inlet Pressure, Chan. 2	PSIG		
22	Pump Inlet Pressure, Chan. 3	PSIG		
23	Pump Inlet Pressure, Chan. 4	PSIG		
24	Pump Inlet Pressure, Chan. 5	PSIG		
25	Pump Inlet Pressure, Chan. 6	PSIG		
26	Pump Inlet Pressure, Chan. 7	PSIG		
27	Pump Inlet Pressure, Chan. 8	PSIG		
28	Pump Outlet Pressure, Chan. 1	PSIG		
29	Pump Outlet Pressure, Chan. 2	PSIG		
30	Pump Outlet Pressure, Chan. 3	PSIG		

BLOCK TRANSFER DATA (continued)

Channel Operational Status – Type 02				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
31	Pump Outlet Pressure, Chan. 4	PSIG		
32	Pump Outlet Pressure, Chan. 5	PSIG		
33	Pump Outlet Pressure, Chan. 6	PSIG		
34	Pump Outlet Pressure, Chan. 7	PSIG		
35	Pump Outlet Pressure, Chan. 8	PSIG		
36	Motor Speed, Chan. 1	RPM x 10		
37	Motor Speed, Chan. 2	RPM x 10		
38	Motor Speed, Chan. 3	RPM x 10		
39	Motor Speed, Chan. 4	RPM x 10		
40	Motor Speed, Chan. 5	RPM x 10		
41	Motor Speed, Chan. 6	RPM x 10		
42	Motor Speed, Chan. 7	RPM x 10		
43	Motor Speed, Chan. 8	RPM x 10		
44	Pressure Control, Chan. 1	0 to 1023		
45	Pressure Control, Chan. 2	0 to 1023		
46	Pressure Control, Chan. 3	0 to 1023		
47	Pressure Control, Chan. 4	0 to 1023		
48	Pressure Control, Chan. 5	0 to 1023		
49	Pressure Control, Chan. 6	0 to 1023		
50	Pressure Control, Chan. 7	0 to 1023		
51	Pressure Control, Chan. 8	0 to 1023		
52	Spare Analog Input, Chan. 1	0 to 1023		
53	Spare Analog Input, Chan. 2	0 to 1023		
54	Spare Analog Input, Chan. 3	0 to 1023		
55	Spare Analog Input, Chan. 4	0 to 1023		
56	Spare Analog Input, Chan. 5	0 to 1023		
57	Spare Analog Input, Chan. 6	0 to 1023		
58	Spare Analog Input, Chan. 7	0 to 1023		
59	Spare Analog Input, Chan. 8	0 to 1023		

BLOCK TRANSFER DATA (continued)

SYSTEM CONFIGURATION - TYPE 03

System Configuration Data – Type 03				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	3
1	BTR Type	3	Next BTR Type	00 to 09
2	N/A	N/A	Next BTR Gun/ Chan. #	1 to 8 or N/A
3	N/A	N/A	Next BTR Job #	1 to 199 or N/A
4	Over Pressure Limit	PSIG	Over Pressure Limit	PSIG
5	Fold Back Pressure	PSIG	Fold Back Pres- sure	PSIG
6	Sensor Limit	PSIG	Sensor Limit	PSIG
7	Horn Enable	0 or 1	Horn Enable	0 or 1
8	Spare 1		Spare 1	
9	Spare 2		Spare 2	
10	Spare 3		Spare 3	
11	Spare 4		Spare 4	
12	Spare 5		Spare 5	
13	Spare 6		Spare 6	
14	Spare 7		Spare 7	
15	Spare 8		Spare 8	
16	Spare 9		Spare 9	
17	Spare 10		Spare 10	
18	Controller IP Address (1)	0 to 255		
19	Controller IP Address (2)	0 to 255		
20	Controller IP Address (3)	0 to 255		
21	Controller IP Address (4)	0 to 255		
22	User Interface SW Version			
23	RIO Card Version			
24	Interface Card SW Version			
25	Channel Card #1 Version			
26	Channel Card #2 Version			
27	Channel Card #3 Version			
28	Channel Card #4 Version			

BLOCK TRANSFER DATA (continued)

GUN CONFIGURATION - TYPE 04

RIO Gun Configuration Block transfers are typically required when configuring a gun for the first time or periodically adjusting parameters.

Gun Configuration Data – Type 04				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	4
1	BTR Type	4	Next BTR Type	00 to 09
2	BTR Gun #	1 to 8	BTW Gun # and Next BTR Gun #	1 to 8
3	N/A	N/A	Next BTR Job #	1 to 199 or N/A
4	Mode	0, 1, or 2	Mode	0, 1, or 2
5	No. of Channels	0 – 2 (4)	No. of Channels	0 – 2 (4)
6	Master Channel	0 – 8	Master Channel	0 – 8
7	Slave #1 Channel	0 – 8	Slave #1 Channel	0 – 8
8	Slave #2 Channel (future)	0 – 8	Slave #2 Channel (future)	0 – 8
9	Slave #3 Channel (future)	0 – 8	Slave #3 Channel (future)	0 – 8
10	Default Job #	0 – 199	Default Job #	0 – 199
11	Number of Applicators	1 – 4	Number of Applicators	1 – 4
12	Mixed Volume	cc's	Mixed Volume	cc's
13	Flow/Ratio Tolerance	0 – 100	Flow/Ratio Tolerance	0 – 100
14	Tolerance Volume	cc's	Tolerance Volume	cc's
15	Auto Reset		Auto Reset	
16	Alarm Tolerance Time	0.1 seconds	Alarm Tolerance Time	0.1 seconds
17	Solvent Calibration Factor (Low Order)	PPL % 10,000	Solvent Calibration Factor (Low Order)	PPL % 10,000
18	Solvent Calibration Factor (High Order)	PPL / 10,000	Solvent Calibration Factor (High Order)	PPL / 10,000
19	Horn Code (see table below)	Bit Field	Horn Code (see table below)	Bit Field
20	Spare 1		Spare 1	
21	Spare 2		Spare 2	
22	Spare 3		Spare 3	
23	Spare 4		Spare 4	
24	Spare 5		Spare 5	

BLOCK TRANSFER DATA (continued)

Possible Horn Codes	
Horn Code Value	Description
XXXXXXXXXXXXX000	Horn never sounds
XXXXXXXXXXXXX001	Horn only sounds on a Spray Shut Down condition
XXXXXXXXXXXXX010	Horn sounds for All Errors (not including expired pot life)
XXXXXXXXXXXXX100	Horn only sounds if the Pot Life Timer expires
XXXXXXXXXXXXX101	Horn sounds if a Spray Shut Down occurs or if the Pot Life Timer expires
XXXXXXXXXXXXX11X	Horn sounds for Any Error (including an expired Pot Life Timer)
Note: X indicates 'don't care'.	

CHANNEL CONFIGURATION - TYPE 05

Channel Configuration Data – Type 05				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	5
1	BTR Type	5	Next BTR Type	00 to 09
2	BTR Chan. #	1 to 8	BTW Chan. # and Next BTR Gun/Chan. #	1 to 8
3	N/A	N/A	Next BTR Job #	1 to 199 or N/A
4	Fill Enable	0 or 1	Fill Enable	0 or 1
5	Trigger On Delay (Master)	0.1 seconds	Trigger On Delay (Master)	0.1 seconds
6	Trigger Off Delay (Master)	0.1 seconds	Trigger Off Delay (Master)	0.1 seconds
7	Pump Size	cc's/revolution	Pump Size	cc's/revolution
8	Calibration Factor (Low Order)	PPL % 10,000	Calibration Factor (Low Order)	PPL % 10,000
9	Calibration Factor (High Order)	PPL / 10,000	Calibration Factor (High Order)	PPL / 10,000
10	Max. Pump Speed	RPM	Max. Pump Speed	RPM
11	Min. Pump Speed	RPM	Min. Pump Speed	RPM
12	Max. Inlet Pressure	PSIG	Max. Inlet Pressure	PSIG
13	Min. Inlet Pressure	PSIG	Min. Inlet Pressure	PSIG
14	Max. Outlet Pressure	PSIG	Max. Outlet Pressure	PSIG
15	Min. Outlet Pressure	PSIG	Min. Outlet Pressure	PSIG
16	Foldback Kp Gain		Foldback Kp Gain	
17	Foldback Ki Gain		Foldback Ki Gain	
18	Foldback Kd Gain		Foldback Kd Gain	

BLOCK TRANSFER DATA (continued)

Channel Configuration Data – Type 05				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
19	Foldback Deadband	PSIG	Foldback Deadband	PSIG
20	Feather Kp Gain		Feather Kp Gain	
21	Feather Ki Gain		Feather Ki Gain	
22	Feather Kd Gain		Feather Kd Gain	
23	Feather Deadband	PSIG	Feather Deadband	PSIG
24	Inlet Pressure Sensor	See Table	Inlet Pressure Sensor	See Table
25	Spare 1		Spare 1	
26	Spare 2		Spare 2	
27	Spare 3		Spare 3	
28	Spare 4		Spare 4	
29	Spare 5		Spare 5	

The Inlet Pressure Sensor bit fields are defined in the following table:

Possible Inlet Pressure Sensor Codes	
Value	Description
0	Control, Minimum, and Maximum Pressure Tests Disabled for All Modes for Both Channels
1	Control, Minimum, and Maximum Pressure Tests Enabled for All Modes for Both Channels
2	Control and Minimum Pressure Test Enabled for All Modes, Except Channel Fill, for Resin Channel Control and Minimum Pressure Test Enabled All Modes for Catalyst Channel Maximum Pressure Test Enabled All Modes for Both Channels

BLOCK TRANSFER DATA (continued)

JOB CONFIGURATION DATA- TYPE 06

RIO Job Configuration Data block transfers are typically required when configuring a gun for the first time or periodically adjusting parameters.

Job Configuration Data – Type 06				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	6
1	BTR Type	6	Next BTR Type	00 to 09
2	BTR Gun #	1 to 8	BTW Gun # and Next BTR Gun #	1 to 8
3	BTR Job #	1 to 199	BTW Job # and Next BTR Job #	1 to 199
4	Ratio (Parts master to 1 part slave)	Ratio x 100	Ratio (Parts master to 1 part slave)	Ratio x 100
5	Flow Setpoint	cc's/min	Flow Setpoint	cc's/min
6	Maximum Flow	cc's/min	Maximum Flow	cc's/min
7	Minimum Flow	cc's/min	Minimum Flow	cc's/min
8	Bar Graph Limit	cc's/min	Bar Graph Limit	cc's/min
9	Potlife Timer	minutes	Potlife Timer	minutes
10	Feather Pressure	PSIG	Feather Pressure	PSIG
11	Fill Volume	cc's	Fill Volume	cc's
12	Pressure Pot Capacity (Master)	cc's	Pressure Pot Capacity (Master)	cc's
13	Delta P (Master)	PSIG	Delta P (Master)	PSIG
14	Min. Fluid Pressure (Master)	PSIG	Min. Fluid Pressure (Master)	PSIG
15	Inlet Kp (Master)		Inlet Kp (Master)	
16	Inlet Ki (Master)		Inlet Ki (Master)	
17	Inlet Kd (Master)		Inlet Kd (Master)	
18	Inlet Deadband (Master)		Inlet Deadband (Master)	
19	Pressure Pot Capacity (Slave)	cc's	Pressure Pot Capacity (Slave)	cc's
20	Delta P (Slave)	PSIG	Delta P (Slave)	PSIG
21	Min. Fluid Pressure (Slave)	PSIG	Min. Fluid Pressure (Slave)	PSIG
22	Inlet Kp (Slave)		Inlet Kp (Slave)	
23	Inlet Ki (Slave)		Inlet Ki (Slave)	
24	Inlet Kd (Slave)		Inlet Kd (Slave)	
25	Inlet Deadband (Slave)		Inlet Deadband (Slave)	
26	Hardener Sample Time (Slave)	0 – 10 sec.	Hardener Sample Time (Slave)	0 – 10 sec.
27	Hardener No Flow (Slave)	0 – 1023	Hardener No Flow (Slave)	0 – 1023

BLOCK TRANSFER DATA (continued)

Job Configuration Data – Type 06				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
28	Hardener Fault On (Slave)	0 – 1023	Hardener Fault On (Slave)	0 – 1023
29	Min. Control Pressure (Master)	PSIG	Min. Control Pressure (Master)	PSIG
30	Min. Control Pressure (Slave)	PSIG	Min. Control Pressure (Slave)	PSIG
31	Spare 1		Spare 1	
32	Spare 2		Spare 2	
33	Spare 3		Spare 3	
34	Spare 4		Spare 4	
35	Spare 5		Spare 5	
36	Spare 6		Spare 6	
37	Spare 7		Spare 7	
38	Spare 8		Spare 8	
39	Spare 9		Spare 9	
40	Spare 10		Spare 10	

FLOW TOTALS - TYPE 07

RIO Flow Totals block transfers are used to read or reset accumulated flow totals during normal operation.

Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	7
1	BTR Type	7	Next BTR Type	00 to 09
2	BTR Chan. #	1 to 8	BTW Chan. # and Next BTR Gun/Chan. #	1 to 8
3	BTR Job #	1 to 199	BTW Job # and Next BTR Job #	1 to 199
4	Daily Total for Job	Liters	Reset Selected	Bit Field
5	Daily Total for Job	cc's		
6	YTD Totals for Job	Liters		
7	YTD Totals for Job	Flow Totals – Type 07		
8	Solvent Totals for Job	Liters		
9	Solvent Totals for Job	cc's		
10	Grand Totals for Job	Liters		
11	Grand Totals for Job	cc's		
12	Channel Fill Totals for Job	Liters		

BLOCK TRANSFER DATA (continued)

Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
13	Channel Fill Totals for Job	cc's		
14	Daily Total for All Jobs	Liters		
15	Daily Total for All Jobs	cc's		
16	YTD Totals for All Jobs	Liters		
17	YTD Totals for All Jobs	cc's		
18	Solvent Totals for All Jobs	Liters		
19	Solvent Totals for All Jobs	cc's		
20	Grand Totals for All Jobs	Liters		
21	Grand Totals for All Jobs	cc's		
22	Channel Fill Totals for All Jobs	Liters		
23	Channel Fill Totals for All Jobs	cc's		
24	Pressure Pot Contents	Liters		
25	Pressure Pot Contents	Cc's		

The Reset Selected bit field is defined in the following table:

Bit	Reset Selected Total	Decimal Value	Hex Value
0	Daily Total for Job	1	0x0001
1	YTD Totals for Job	2	0x0002
2	Solvent Totals for Job	4	0x0004
3	Grand Totals for Job	8	0x0008
4	Channel Fill Totals for Job	16	0x0010
5	Daily Total for All Jobs	32	0x0020
6	YTD Totals for All Jobs	64	0x0040
7	Solvent Totals for All Jobs	128	0x0080
8	Grand Totals for All Jobs	256	0x0100
9	Channel Fill Totals for All Jobs	512	0x0200
10	Pressure Pot Contents (from Job Configuration value)	1024	0x0400

Note: If it is necessary to retrieve flow totals after every job (buck, part, batch, etc.) it is important to note that the RCS-2 interface card only receives totalization information once every second from the channel card. (The interface card is the card that stores that information in battery-backed RAM and supplies this data to the RCS-2 RIO card.) For that reason, in order to insure accurate totalization data, it is necessary to wait at least one second after the gun trigger shuts off after spraying the last part in the batch (buck, etc.) before requesting totalization data.

BLOCK TRANSFER DATA (continued)

ERROR LOG - TYPE 08

RIO Error Log block transfers are used to obtain a list of the past ten faults recorded by the RCS-2 Interface Module. The BTW has no effect on the system and may be used to schedule the next block transfer.

Error Log Messages – Type 08				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	8
1	BTR Type	8	Next BTR Type	00 to 09
2	N/A	N/A	Next BTR Gun/Chan. #	1 to 8 or N/A
3	BTR Reference #	1 to 100	Next BTR Job # or Ref. #	1 to 199 or N/A or 1 to 100
4	Ref. # + 0	1 to 100	Clear Error Log	1
5	Error Code	(see table)		
6	Channel #	1 to 8		
7	Time Stamp (High)	Sec. since 1/1/80		
8	Time Stamp (Low)	Sec. since 1/1/80		
9	Ref. # + 1	2 to 100		
10	Error Code	(see table)		
11	Channel #	1 to 8		
12	Time Stamp (High)	Sec. since 1/1/80		
13	Time Stamp (Low)	Sec. since 1/1/80		
14	Ref. # + 2	3 to 100		
15	Error Code	(see table)		
16	Channel #	1 to 8		
17	Time Stamp (High)	Sec. since 1/1/80		
18	Time Stamp (Low)	Sec. since 1/1/80		
19	Ref. # + 3	4 to 100		
20	Error Code	(see table)		
21	Channel #	1 to 8		
22	Time Stamp (High)	Sec. since 1/1/80		
23	Time Stamp (Low)	Sec. since 1/1/80		
24	Ref. # + 4	5 to 100		
25	Error Code	(see table)		
26	Channel #	1 to 8		
27	Time Stamp (High)	Sec. since 1/1/80		
28	Time Stamp (Low)	Sec. since 1/1/80		
29	Ref. # + 5	6 to 100		
30	Error Code	(see table)		
31	Channel #	1 to 8		

BLOCK TRANSFER DATA (continued)

Error Log Messages – Type 08				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
32	Time Stamp (High)	Sec. since 1/1/80		
33	Time Stamp (Low)	Sec. since 1/1/80		
34	Ref. # + 6	7 to 100		
35	Error Code	(see table)		
36	Channel #	1 to 8		
37	Time Stamp (High)	Sec. since 1/1/80		
38	Time Stamp (Low)	Sec. since 1/1/80		
39	Ref. # + 7	8 to 100		
40	Error Code	(see table)		
41	Channel #	1 to 8		
42	Time Stamp (High)	Sec. since 1/1/80		
43	Time Stamp (Low)	Sec. since 1/1/80		
44	Ref. # + 8	9 to 100		
45	Error Code	(see table)		
46	Channel #	1 to 8		
47	Time Stamp (High)	Sec. since 1/1/80		
48	Time Stamp (Low)	Sec. since 1/1/80		
49	Ref. # + 9	10 to 100		
50	Error Code	(see table)		
51	Channel #	1 to 8		
52	Time Stamp (High)	Sec. since 1/1/80		
53	Time Stamp (Low)	Sec. since 1/1/80		

The following table describes the Error Codes:

Error Code	Description
	(Note: Bold Indicates Always Hard Errors)
0	No Error
1	Interface Module Battery Low
2	Interface not communicating with channel card in slot 1
3	Interface not communicating with channel card in slot 2
4	Interface not communicating with channel card in slot 3
5	Interface not communicating with channel card in slot 4

BLOCK TRANSFER DATA (continued)

Error Code	Description (Note: Bold Indicates Always Hard Errors)
6 – 31	(spare error codes)
32	Input Under Pressure
33	Input Over Pressure
34	Output Under Pressure
35	Output Over Pressure
36	Flow Out of Tolerance
37	Hardener Flow Loss
38	Pressure Pot Empty
39	(spare error bit)
40	(spare error bit)
41	Inlet Pressure Loss
42	Outlet Pressure Loss
43	Analog Remote Loss
44	Ratio Out of Tolerance
45	(spare error code)
46	Motor Amp Fault
47	Analog Feather Loss
48	Analog Spare Loss
49	Fold Back Pressure Reached
50	Pot Life Expired
51	(spare error code)
52	(spare error code)
53	(spare error code)
54	(spare error code)
55	(spare error code)
56	(spare error code)
57	(spare error code)
58	(spare error code)
59	(spare error code)
60	System Over Pressure
61	Channel Card (Pressure) Parameter Fault
62	Channel Card SPI Communication Lost
63	Channel Card Internal Software Fault

BLOCK TRANSFER DATA (continued)

ALARM CONFIGURATION - TYPE 09

RIO Alarm Configuration block transfers allow the user the ability to determine what alarm conditions causes a spray-shutdown.

Configure Alarms – Type 09				
Word	BTR		BTW	
	Description	Units/Value	Description	Units/Value
0	Previous BTW Type	00 to 09	BTW Type	9
1	BTR Type	9	Next BTR Type	00 to 09
2	N/A	N/A	Next BTR Gun #	1 to 8 or N/A
3	N/A	N/A	Next BTR Job #	1 to 199 or N/A
4	Alarm Enable/Disable Bits 0-15	Bit Field	Alarm Enable/Disable Bits 0-15	Bit Field
5	Alarm Enable/Disable Bits 16-31	Bit Field	Alarm Enable/Disable Bits 16-31	Bit Field

The Active Alarm bit fields are defined in the following table:

Bit	Alarm Enable/Disable (Note: Bold Indicates Always Hard Alarms)	Decimal Value	Hex Value
0	Input Under Pressure	1	0x0001
1	Input Over Pressure	2	0x0002
2	Output Under Pressure	4	0x0004
3	Output Over Pressure	8	0x0008
4	Flow Out of Tolerance	16	0x0010
5	Hardener Flow Loss	32	0x0020
6	Pressure Pot Empty	64	0x0040
7	(spare error bit)	128	0x0080
8	(spare error bit)	256	0x0100
9	Inlet Pressure Loss	512	0x0200
10	Outlet Pressure Loss	1024	0x0400
11	Analog Remote Loss	2048	0x0800
12	Ratio Out of Tolerance	4096	0x1000
13	(spare error bit)	8192	0x2000
14	Motor Amp Fault	16384	0x4000
15	Analog Feather Loss	32768	0x8000
16	Analog Spare Loss	1	0x0001
17	Fold Back Pressure Reached	2	0x0002
18	Pot Life Expired	4	0x0004
19	(spare error bit)	8	0x0008
20	(spare error bit)	16	0x0010

BLOCK TRANSFER DATA (continued)

Bit	Alarm Enable/Disable (Note: Bold Indicates Always Hard Alarms)	Decimal Value	Hex Value
21	(spare error bit)	32	0x0020
22	(spare error bit)	64	0x0040
23	(spare error bit)	128	0x0080
24	(spare error bit)	256	0x0100
25	(spare error bit)	512	0x0200
26	(spare error bit)	1024	0x0400
27	(spare error bit)	2048	0x0800
28	System Over Pressure	4096	0x1000
29	Channel Card (Pressure) Parameter Fault	8192	0x2000
30	Channel Card SPI Communication Lost	16384	0x4000
31	Channel Card Internal Software Fault	32768	0x8000

Section 8: APPENDIX

DESCRIPTIONS OF INPUTS AND OUTPUTS

SYSTEM INPUTS

Gun Strobe

Type of Input: Gun

Type of Signal: Pulsed

This input signal is used in coordination with the Job Number inputs (see below). When this input is taken from the non-energized state to the energized state for any gun, the Job Number that is appearing at the Job Number inputs is loaded into the job queue. If the gun is in the halted state, the new job becomes active immediately. If the gun is in a run state, the new job number is held in the queue until the next time the gun is halted (or faults). Note that the job queue is only one in length. If another job is loaded on top of one already in the queue, the new job number overwrites the older one in the queue.

Job Number [1, 2, 4, 8, 10, 20, 40, 80, 100]

Type of Input: System

Type of Signal: Maintained

These inputs are simple BCD (binary coded decimal) inputs that represent the job number that an external controller energizes to load new job numbers into the RCS-2 guns. Note that these inputs are common to all guns and they are ignored until one or more of the Gun Strobe inputs are pulsed. Allowable job number range from 1 to 199.

SYSTEM OUTPUTS

System Fault

Type of Output: System

Type of Signal: Maintained

This output is connected to the horn in the top of the control console on the stand-alone RCS-2 controllers. It can be energized any-time there is a system fault. (It can be enabled and disabled on the CONFIG SYSTEM screen). Some examples of system faults are problems with the disk drive, hard drive, or CDROM of the user-interface PC. Also, certain problems with the interface board or RIO board (if used) may cause a system fault. This output can also be programmed to energize when any of the guns fault. This is done on the CONFIG GUN screens. Each gun can be configured to cause the horn to sound when it faults independent of each other. Note that the horn must be enabled on the CONFIG SYSTEM screen or the horn will not sound for gun faults regardless of whether or not they are configured to do so on the CONFIG GUN screens.

System Pulse

Type of Output: System

Type of Signal: Pulsing

This output pulses at approximately a 0.5 hertz rate as long as the processor on the interface board does not detect any on-board firmware problems. Users may wish to use this signal to detect when the RCS-2 controller is powered up and running.

Client Connected

Type of Output: System

Type of Signal: Maintained

This output is energized whenever a client (P.C.) is connected and talking to the interface card via Ethernet.

DISCRETE CHANNEL AND GUN INPUTS

Fast Fill

Type of Input: Gun

Type of Signal: Pulsed

The gun must be in run mode or volume fill mode prior to initiating this mode or the RCS-2 controller will ignore it. If the gun is configured as a single channel gun and this signal is pulsed, the gun will cause the pump to run at its maximum speed (typically 150 RPM) until the halt signal is pulsed. (Note that it is not necessary to have the trigger signal energized. Flow starts immediately.) If the gun is configured as a two-channel gun, and this input is pulsed, the pumps will run at the maximum speed possible while maintaining the target ratio. That is, the software will determine which of the two pumps can be run at its maximum speed and run the opposite channel at whatever speed necessary to insure the proper ratio of component A to component B. The software determines this based on the programmed pump sizes and the programmed ratio. Pulsing the halt/reset input takes the gun out of the fast fill mode. (Note also paragraph below describing using fast fill with volume fill.)

Channel Fill

Type of Input: Channel

Type of Signal: Pulsed

A gun must be in the halted state to use this mode. This mode functions the same for single channel guns as it does for dual channel guns. When this input is pulsed, the pump for that channel is run at its maximum rate (150 RPM) until the halt signal is pulsed. It is not necessary for the trigger input to be energized. If it is desired to have both channels of a two channel gun run at full speed (for flushing, etc.) this input must be pulsed on both channels independently. Note that the pilot air signal to the inlet pressure regulator is automatically set to 100 psi while in channel fill mode.

Feather Set

Type of Input: Gun

Type of Signal: Pulsed

If the gun is configured as a manual mode gun and the value zero (0) is programmed in for feather pressure (under the CONFIG JOB parameters) this input can be used to program the feather pressure 'on the fly'. That is, if a hand sprayer is painting and this input is momentarily energized, the RCS-2 controller takes a snapshot of the outbound pressure of the pumps (or the pressure at the feather pressure sensor, if being used) and then starts controlling the speed of the pumps to maintain that pressure. The optional Remote Operator's Panel has a pushbutton on it that allows the hand sprayer to utilize this feature.

Run

Type of Input: Gun

Type of Signal: Pulsed

This signal takes a configured gun from the halted state to the "run" state. In order for a gun to spray, it must first be put into run mode. It is essentially a way of enabling a gun. Energizing the trigger input of a gun will not cause fluid to flow unless the gun has been placed in run mode. When placed in run mode, the discrete output labeled Gun Run will be energized.

Halt/Fault Reset

Type of Input: Gun

Type of Signal: Pulsed

This input takes a configured gun that is in run mode to the halted state, essentially disabling the gun from spraying. It also resets a fault for the gun if it is in the faulted state.

Trigger [1, 2, 3 or 4]

Type of Input: Gun

Type of Signal: Maintained

This input tells the controller to run the pumps if and only if the gun has first been placed in run mode. The additional trigger input signals (2, 3, and 4) can be used in cases where the output of a fluid panel is split between multiple applicators. They work in conjunction with each other to allow up to 4 independent triggers, one for each of 4 applicators. The software can be configured in such a way that if one of these inputs is on, the fluid panel delivers the target flow rate of material. If a second input is turned on, then the fluid panel will deliver twice the target flow rate. If a third input is energized, three times the target flow is delivered and if all four inputs are energized, the fluid panel will deliver four times the target flow rate. It is assumed that each of these inputs are also connected to the trigger inputs on four independent applicators.

DISCRETE CHANNEL AND GUN INPUTS

Motor Amp Enable

Type of Input: Channel

Type of Signal: Maintained

This is an input to the controller from the motor amplifier indicating that the motor amplifier has detected a problem and has placed itself in a faulted condition.

Volume Fill

Type of input: Gun

Type of signal: Pulsed

By pulsing the volume fill discrete input, the unit will be put into the V. FILL mode. (The gun must be in the halted state prior to this.) When the gun trigger input goes high, the pumps will run at the programmed flow rate and ratio until the volume programmed in for Fill Volume (on the Job parameters screen) is dispensed. If more than one gun trigger input goes high the unit will multiply the flow rate by the number of high inputs but still only run until the programmed volume is dispensed. When that volume is reached, the gun will be halted. See paragraph labeled "Volume Fill with Fast Fill" below if it is necessary to run this mode in parallel with fast fill.

Pushout

Type of input: Gun

Type of signal: Maintained

This input when energized puts the gun in "Pushout Mode". When initiated, the RCS-2 will immediately turn off the catalyst pump and speed up the resin pump to maintain the target flow rate that was being sprayed prior to the initiation of the pushout signal. (Note that this pushout signal is a maintained signal.) The RCS-2 will continue to deliver fluid out of the first dual purge side until the volume programmed in for mixed volume has been sprayed and then that gun will automatically be halted (taken out of run mode). This state will be recognized by the PLC or robot when the Run output from the RCS-2 turns off. For more information on using this function, refer to the Operator's Manual.

Volume Fill with Fast Fill Mode:

It is possible to Volume Fill and Fast Fill simultaneously. If the gun is put into Volume Fill mode, and then the Fast Fill input is pulsed, the unit will run in Fast Fill mode until the volume programmed in for fill volume is dispensed. At that time, the gun will be halted. This happens regardless of the condition of the gun trigger inputs so make sure the applicator is triggered or an overpressure fault may occur. When it is desirable to run both modes in parallel, it is important to watch the Run output bit to insure the unit has in fact gone into Volume Fill mode prior to sending the Fast Fill bit.

DISCRETE CHANNEL AND GUN OUTPUTS

Fault

This output is energized anytime a fault condition is recognized by the software. Even if the fault is disabled (known as a soft-fault) on the Configured Alarms screen, this output will be energized as long as the condition persists. Fluid flow will not be halted when this output is energized unless it is configured to do so on the Configured Alarms screen. If it is configured to be a hard-fault, this output and the Spray Shutdown output will both be energized and the system will stop spraying (see Spray Shutdown, below).

Run

This output is energized if the gun is configured properly, a good job number has been loaded, and the gun has been placed in Run mode or the Volume Fill mode. This output goes off if a fault occurs, if it is Halted, or in the Ready state.

Spray Shutdown

This output is energized if a fault condition exists and the specific fault that exists is enabled on the Configured Alarms screen (turned on). This indicates that the flow of fluid from the fluid panel has been stopped as the result of a detected fault condition.

Flush Request

This output is energized when the pot-life timer has expired. (For more information, see "Mixed Volume and Pot-Life Timer" in the "Operation's Manual".)

Motor On

This output is energized by the software when it wants the motor to turn. As long as this output is enabled and the motor amplifier is not faulted, the pump will be held rigid in place by the motor amplifier. If this output is not on, the pump is allowed to free-wheel.

DISCRETE CHANNEL AND GUN INPUTS

Motor Amp Enable

Type of Input: Channel

Type of Signal: Maintained

This is an input to the controller from the motor amplifier indicating that the motor amplifier has detected a problem and has placed itself in a faulted condition.

Volume Fill

Type of input: Gun

Type of signal: Pulsed

By pulsing the volume fill discrete input, the unit will be put into the V. FILL mode. (The gun must be in the halted state prior to this.) When the gun trigger input goes high, the pumps will run at the programmed flow rate and ratio until the volume programmed in for Fill Volume (on the Job parameters screen) is dispensed. If more than one gun trigger input goes high the unit will multiply the flow rate by the number of high inputs but still only run until the programmed volume is dispensed. When that volume is reached, the gun will be halted. See paragraph labeled "Volume Fill with Fast Fill" below if it is necessary to run this mode in parallel with fast fill.

Pushout

Type of input: Gun

Type of signal: Maintained

This input when energized puts the gun in "Pushout Mode". When initiated, the RCS-2 will immediately turn off the catalyst pump and speed up the resin pump to maintain the target flow rate that was being sprayed prior to the initiation of the pushout signal. (Note that this pushout signal is a maintained signal.) The RCS-2 will continue to deliver fluid out of the first dual purge side until the volume programmed in for mixed volume has been sprayed and then that gun will automatically be halted (taken out of run mode). This state will be recognized by the PLC or robot when the Run output from the RCS-2 turns off. For more information on using this function, refer to the Operator's Manual.

Volume Fill with Fast Fill Mode:

It is possible to Volume Fill and Fast Fill simultaneously. If the gun is put into Volume Fill mode, and then the Fast Fill input is pulsed, the unit will run in Fast Fill mode until the volume programmed in for fill volume is dispensed. At that time, the gun will be halted. This happens regardless of the condition of the gun trigger inputs so make sure the applicator is triggered or an overpressure fault may occur. When it is desirable to run both modes in parallel, it is important to watch the Run output bit to insure the unit has in fact gone into Volume Fill mode prior to sending the Fast Fill bit.

DISCRETE CHANNEL AND GUN OUTPUTS

Fault

This output is energized anytime a fault condition is recognized by the software. Even if the fault is disabled (known as a soft-fault) on the Configured Alarms screen, this output will be energized as long as the condition persists. Fluid flow will not be halted when this output is energized unless it is configured to do so on the Configured Alarms screen. If it is configured to be a hard-fault, this output and the Spray Shutdown output will both be energized and the system will stop spraying (see Spray Shutdown, below).

Run

This output is energized if the gun is configured properly, a good job number has been loaded, and the gun has been placed in Run mode or the Volume Fill mode. This output goes off if a fault occurs, if it is Halted, or in the Ready state.

Spray Shutdown

This output is energized if a fault condition exists and the specific fault that exists is enabled on the Configured Alarms screen (turned on). This indicates that the flow of fluid from the fluid panel has been stopped as the result of a detected fault condition.

DISCRETE CHANNEL AND GUN OUTPUTS

Flush Request

This output is energized when the pot-life timer has expired. (For more information, see "Mixed Volume and Pot-Life Timer" in the "Operation's Manual".)

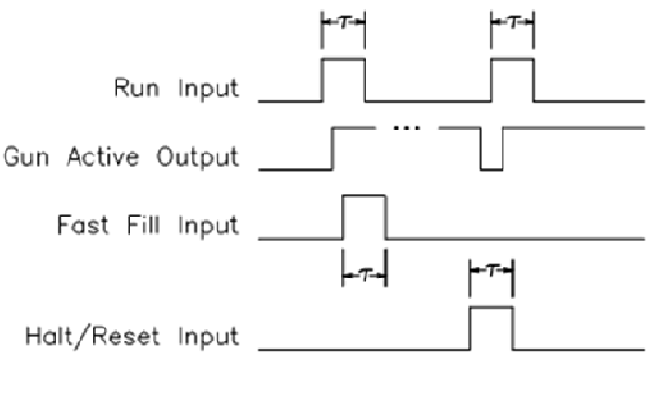
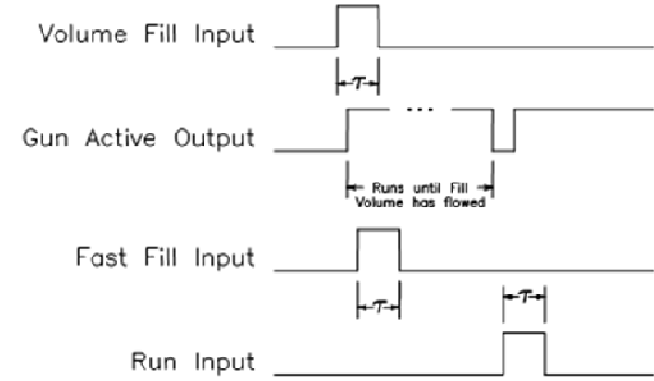
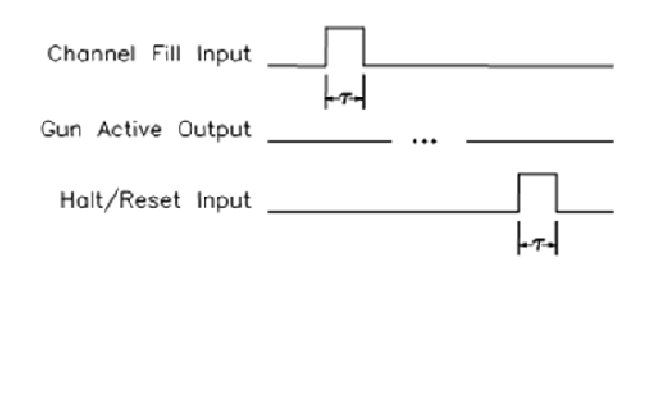
Motor On

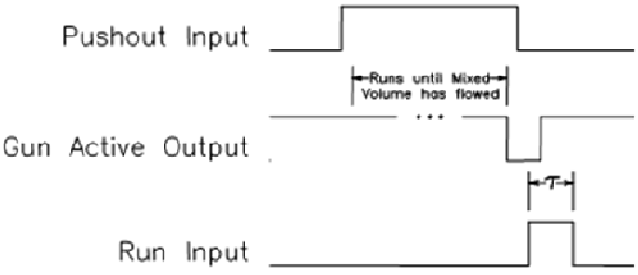
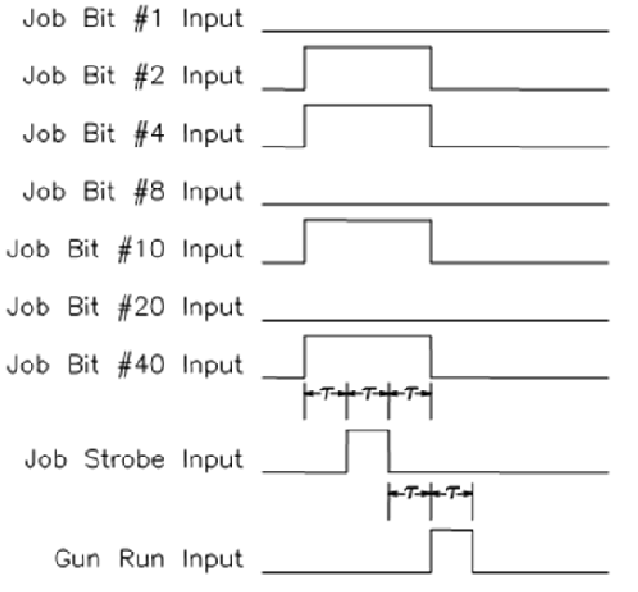
This output is energized by the software when it wants the motor to turn. As long as this output is enabled and the motor amplifier is not faulted, the pump will be held rigid in place by the motor amplifier. If this output is not on, the pump is allowed to free-wheel.

RECOMMENDED DIGITAL I/O TIMING SEQUENCES

The recommended timing sequences below should be used when controlling the RCS-2 from a PLC. Time τ displayed in these charts should be programmed to be approximately 0.25 second (250 milliseconds) if the RCS-2 is connected via discrete I/O or if done via RIO with the RCS-2 being the only remote device on the RIO channel. If there are additional devices on the RIO channel (including additional RCS-2 racks), this time may (and probably will) have to be extended. (This assumes a baud rate of 230 Kbaud is used on the RIO link.)

Action	Signal Sequence	Notes
Placing the "Gun" in Run Mode		It is necessary to put the gun in run mode to enable it prior to sending it a trigger signal to start flow.
Fault, Halt/Reset then Run		If a gun is faulted and it is necessary to clear the fault and put it back in run mode, use this sequence.
Volume Fill followed by Run		Volume Fill allows the user to program in a fill volume. When put in this mode the unit will flow material until the fill volume has flowed into the fluid line and then the unit will halt and return to the Ready state. The unit should then be placed in run mode to await the trigger signal.

Fast Fill (Time-based)		<p>Since 2k materials are ratioed during fast fills, it is necessary to first put the unit in run mode then initiate fast fill mode. A trigger signal is not required. Use a halt signal to exit fast fill mode. (Pumps spin immediately upon reception of the fast fill bit.</p>
Volume Fill with Fast Fill		<p>It is possible to fast fill while in volume fill mode. Volume fill mode must be initiated first. Wait for the active signal to be asserted prior to initiating the fast fill bit.</p>
Channel Fill (A Fill, B Fill, or AB Fill)		<p>Gun must not be in the run state to use channel fill. When a channel fill is received, the pump starts spinning immediately; a trigger signal is not required. The Gun Active output is not asserted while in A or B Fill modes. A Halt is required to take it out of A or B Fill modes.</p>

Pushout	 <p>The diagram shows three signals over time. The 'Pushout Input' signal is a single pulse. The 'Gun Active Output' signal is low until the pulse, then rises and stays high for a duration labeled 'Runs until Mixed Volume has flowed' before falling. The 'Run Input' signal is low until the pulse, then rises for a short duration labeled 'T' and then falls.</p>	<p>Pushout mode allows the user to pushout a plural component material with a single component material such as solvent. The catalyst motor is halted and the resin motor speeds up to maintain the target flow rate.</p>
Strobe in New Job Number	 <p>The diagram shows eight signals over time. 'Job Bit #1 Input' through 'Job Bit #20 Input' are all low. 'Job Bit #40 Input' is a pulse. 'Job Strobe Input' is a pulse that occurs while 'Job Bit #40 Input' is high. The duration of 'Job Strobe Input' is labeled with two 'T' intervals. 'Gun Run Input' is a pulse that occurs after 'Job Strobe Input' falls, with its duration also labeled with two 'T' intervals.</p>	<p>When loading a new job, the job bits must be asserted prior to strobing the gun strobe input bit and those bits should remain on slightly after the strobe bit goes off.</p>

RECOMMENDED SEQUENCES FOR BLOCK TRANSFERS

The recommended sequences below should be used when sending and receiving data to and from the RCS-2 from a PLC via the RIO link. Time is not indicated on this chart as it will vary from system to system (based on how busy the RIO channel is). If there are additional devices on the RIO channel (including additional RCS-2 racks), times will be extended. (Once again, it is highly recommended that a baud rate of 230 Kbaud be used on the RIO link.)

Action	Step 1	Step 2	Step 3	Step 4	Step 5	Step 6	Step 7
Retrieving Flow Totalization Data (See Note 1)	Wait: After the trigger has turned off after spraying the last part, wait one second to allow the interface card to gather data from the channel card(s).	Execute: BTW (Type 07)	Wait: For response from the RCS that it has received the BTW.	Execute: BTR (Type 07), asking RCS to send data.	Wait: For response from RCS that it has completed sending the requested data.	Check for Errors: Check RIO status register to insure no errors occurred during transmission. (If there was an error, resend the BTR.)	Copy and use data: Copy the data returned from temporary storage location in PLC to area used for storage or manipulation of data.
Retrieving Fault Data (See Note 2)	Monitor: Monitor either the Fault output bit or the Spray Shutdown bit via discrete I/O or via RIO.	Execute: BTW (Type 08)	Wait: For response from the RCS that it has received the BTW.	Execute: BTR (Type 08), asking RCS to send data.	Wait: For response from RCS that it has completed sending the requested data.	Check for Errors: Check RIO status register to insure no errors occurred during transmission. (If there was an error, resend the BTR.)	Copy and use data: Copy the data returned from temporary storage location in PLC to area used for storage or manipulation of data.
Modifying System, Job, Gun, or Channel Parameters (See Note 3)	Execute BTW (System, Type 03) (Gun, Type 04) (Channel, Type 05) (Job, Type 06)	Wait: For response from the RCS that it has received the BTW.	Execute: BTR, asking RCS to send data.	Wait: For response from RCS that it has completed sending the requested data.	Check for Errors: Check RIO status register to insure no errors occurred during transmission. (If there was an error, resend the BTR.)	Modify the parameter or parameters in PLC temporary storage register(s) that you wish to change in the RCS.	Execute BTW to send modified data back to RCS. Step 8 Check RIO status register to insure no errors occurred during transmission.

Note 1: Keep in mind that for a dual component gun, steps 2 through 7 have to be executed twice, once for the resin, then again for the catalyst. Then, if it is necessary to reset the totals, a third set of steps is required to do the reset.

Note 2: There are two digital output bits, Fault and Spray Shutdown. If the fault that occurs is configured as a soft-fault (disabled on the Config Alarms screen) the Fault output bit goes on but the Spray Shutdown bit does not. If the fault that occurs is configured as a hard-fault, both the Fault bit and the Spray Shutdown bit go on and the unit shuts down (stops spraying). It is up to the programmer to decide if they want to retrieve fault data under either or both conditions.

Note 3: Anytime data is changed in the RCS via RIO it should be done in a read-modify-write pattern since only one parameter cannot be sent at a time. This will insure that bad data is not sent to the RCS unit as it does not filter data that comes in via RIO as it does the data coming in from the user-interface P.C.

CHANGES TO MANUAL

April 1, 2009 (Rev. E), Pages 5 and 6: Dip switch settings for RIO Rack Address 20 – 23, 30 – 34, 40 - 47 corrected.

April 17, 2009 (Rev. E), Page 9: Changed Spare User Link text in table to User Link Active.

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Product Manual Price: \$50.00 (U.S.)

Manufacturing

1910 North Wayne Street
Angola, Indiana 46703-9100
Telephone: 260-665-8800
Fax: 260-665-8516

Technical Service - Assistance

320 Phillips Ave.
Toledo, Ohio 43612-1493
Telephone (toll free): 800-233-3366
Telephone: 419-470-2021
Fax: 419-470-2040

Technical Support Representatives can direct you to the appropriate telephone number for ordering spare parts.

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