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6XX
BAGGAGE HANDLING SYSTEM (BHS) INTERFACE SPECIFICATION

Rapiscan systems
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Description:

6XX BHS INTERFACE SPECIFICATION

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1.0 Document Summary

Document Purpose

This document specifies the interface between the 6XX Series machine and the airport Baggage Handling System (BHS).

Document Scope

The scope of this document is the 6XX Series machine, which is a standard Rapiscan Systems product.

A typical operational deployment of the 6XX Series system is shown in

Figure **1** below.

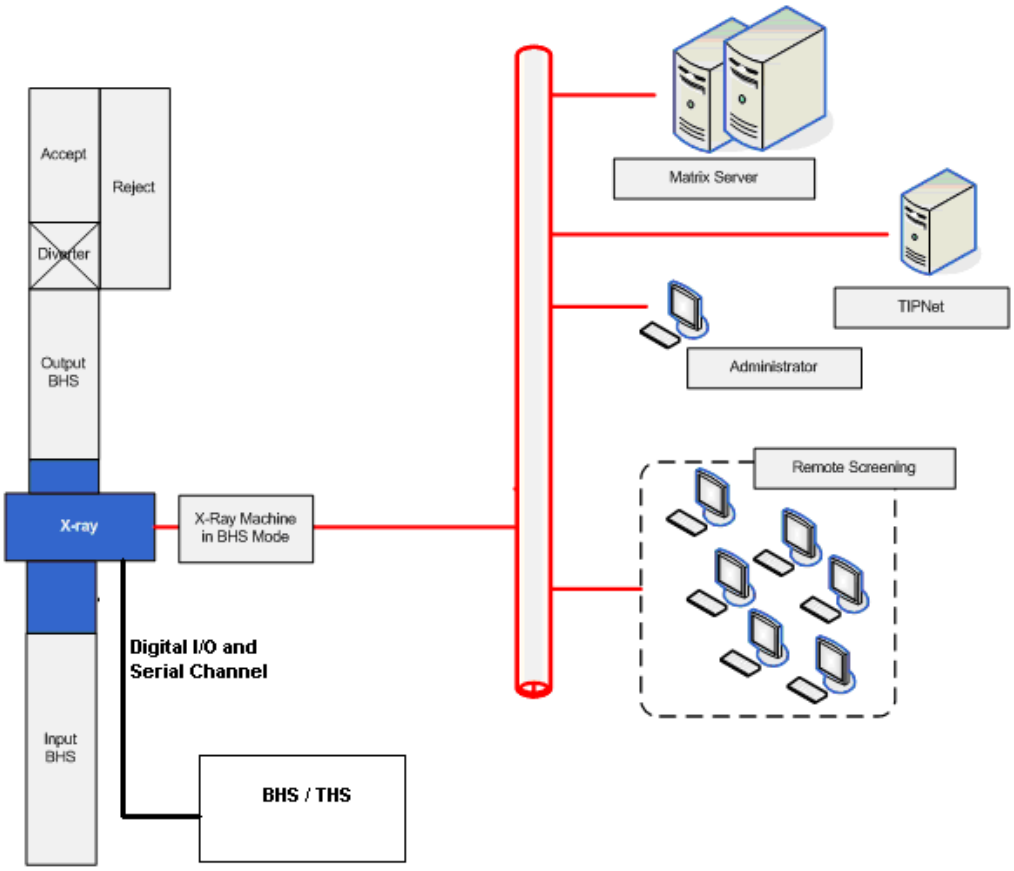


Figure 1: Operational Deployment of 6XX System (optional features shown).

Topics Covered

This specification outlines:

- the parameters for interfacing the into a BHS environment,
- the method of operation of the 6XX SERIES with the BHS, and
- the signals and interface commands provided by the 6XX SERIES to integrate with the BHS.

Statement of Accuracy and Content Variability

Every effort has been made to verify that the specifications presented herein are accurate at the time of publishing. However, in the process of continual improvement, both software and hardware design and specifications may be subject to change without notice.

Since Rapiscan is fully ISO 9001:2000 compliant, all software upgrades and all hardware revisions are fully documented. Further, all such changes that occur after the publication of these Specifications, will be incorporated into the next release of this document, and taken into account in planned equipment delivery and installations.

Please consult with your Rapiscan Interface Specialist to resolve any questions before finalizing equipment installation designs.

2.0 Introduction

Rapiscan Systems is a leading provider of security screening technology to the aviation security market. With extensive international experience in the sale, delivery, commissioning, and service of advanced, mission-critical systems to airports around the world, Rapiscan Systems has a unique and deep understanding of the operating environment of a world class international airport.

3.0 References

- Appropriate model operator and maintenance manuals

4.0 Glossary

Acronyms

BHS: Baggage Handling System

THS: Tray Handling System

CIP: Customer Interface Panel (Section 7.0)

BPI: Baggage & Parcel Inspection

PLC: Programmable Logic Controller (4.1.10)

NO: Normally Open (contact)

NC: Normally Closed (contact)

SPST: Single Pole Single Throw (relay / switch)

SPDT: Single Pole Double Throw (relay / switch)

RSS: Remote Search Station

PEC: Photo Electric Cell (also called sensor)

BPH: Bags per Hour

Terminology and Definitions

4.1.1 **Inline**

In the context of a **6XX Series Machine**, "inline" means that the 6XX is connected to and communicates with the BHS via its Customer Interface Panel (section 7.0), and is also physically connected to one or more BHS conveyor systems and PLCs.

4.1.2 **Level 2 or Remote Screening: Human operator analysis of all screened bags**

Remote Screening is defined as a human operator at a computer workstation screening a bag image sent from the X-Ray Scanner in a matrix environment. This operator is also called a Level 2 operator or Level 2 screener. The Level 2 operator is only able to view the images and give decisions on the images. He is NOT able to perform remote operation or remotely activate any form of Emergency Stop on any machine in the matrix.

4.1.3 **Bag:**

Item, bag or parcel being scanned by the 6XX SERIES machine.

4.1.4 **Machine:**

6XX SERIES machine May also be referred to as "System", "X-Ray System", "X-Ray Scanner" or just "machine".

4.1.5 **Scan-mode:**

6XX SERIES is in "**Scan**" mode if the scanning software is running.

In this mode, machine is able to inspect bags and give decisions.

All BHS Interface signals will be functional in this mode.

There are 2 sub-modes of operation in the Scan-mode;

I. Remote Scan-mode:

In this mode, the machine is connected to the 6XX Matrix Network with the Level 2 operators connected to the Matrix remotely to screen the bags.

II. Local Scan-mode:

In this mode, the machine is directly connected to a local operator to screen the bags.

For more explanation on the 2 sub-modes of operation, refer to Section **10.0 BHS Scenarios - Description of Operation of Signals**

4.1.6 **Transport or No-Scan-mode:**

6XX SERIES is in "**Transport**" mode if the scanning software is not running

In this mode, the 6XX SERIES is not able to send images to L2 operators and deliver decisions for bags to the BHS. No decisions are being provided by the X-Ray System.

Not all BHS Interface signals are available in this mode.

4.1.7 **Dieback:**

This is a state of the machine where the BHS stops the conveyor of the machine due to specific conditions that exist in the BHS. Some examples of these conditions are;

Conveyor on the output of the machine is full and cannot accept any bags sent by the machine

Conveyors downstream from the machine have stopped due to their dieback or emergency-stop conditions

Generally, this state will be forced by the BHS during the machine operation and usually lasts for short durations.

4.1.8 **Signal ASSERTED, TRUE or ON:**

All terms mean that the signal is activated.

4.1.9 **Signal DE-ASSERTED, FALSE or OFF:**

All terms mean that the signal is de-activated.

4.1.10 **Programmable Logic Controller (PLC)**

One of a set of digital computers used to control the conveyor systems of a BHS and Baggage & Parcel Inspection (BPI) System. Each PLC is able to accept digital inputs, and can be programmed to perform logical operations (including time delays) on these inputs prior to outputting digital control signals to the BHS and the BPI systems.

4.1.11 **6XX Matrix Network**

The 6XX Matrix Network is the central hub that transfers information between networked 6XX X-Ray Scanners and networked Remote Screening Workstations (4.1.2).

5.0 Integrating the 6XX into the Baggage Handling System

6XX Series Description

The 6XX SERIES, as shown in Figure 2 below, consists of a family of machines with different tunnel sizes (to screen baggage and parcels of different categories of dimensions) and either single or dual-view imaging capability.

Figure 2: 6XX Series X-Ray Scanner Machine (628XR shown)

The 6XX SERIES X-Ray Scanners use high-resolution, dual-energy X-Ray images from 1 or 2 views to enable the operators to evaluate the images and deliver decisions.

Some of the models in the 6XX SERIES include: 629XR and 628XR.

6.0 Bag Processing Overview

The 6XX SERIES integrates into a BHS that may include a baggage transport conveyor, bag identification readers, bag sorting systems, and computer control systems.

Level 1 Screen Processing

The BHS delivers bags to the 6XX SERIES for screening all the bags that pass through it. Each bag ID number is read by the BHS before the bag enters the machine. When the machine detects the bag in its tunnel, it requests a BagID for the bag from the BHS. When this request is received, the BHS responds back with a unique BagID for that bag to the machine.

After bag passes through the X-Ray camera/s, the machine transfers the image/s to the Level 2 operator for analysis and decision.

Level 2 Screen Processing

When the Level 2 operator receives the image/s of a bag from a machine, he / she uses all the available image enhancement tools and inspects the contents of the bag. After inspection, the operator will deliver an “Accept” or “Reject” decision for the bag by clicking the appropriate button on the workstation software.

This Level 2 workstation decision is routed back to the BHS through the machine that scanned that particular bag.

7.0 Customer Interface Panel (CIP)

The Customer Interface Panel (CIP) built into each 6XX SERIES machine provides the physical communications interface between the machine and other equipment, including the BHS.

The machine conveys signals to the BHS on system status, conveyor status, bag scanning and decisions via the CIP.

The signals consist of dry-contact inputs and outputs as well as one serial link to support transfer of BagID and Level 2 decisions information between the machine and the BHS.

The BHS company must provide all the cables required by the interface to connect to the CIP.

Input / Output Interfaces

The CIP uses terminal connections for Input and Output signals.

Digital Inputs to machine must be volt-free.

Digital Outputs from the machine will be volt-free contacts. Each contact is rated at 24VDC, 30mA max

Serial Communications

A serial input to the 6XX SERIES is the receive signal of a serial port. The serial output from the 6XX SERIES is the transmit signal of a serial port.

The CIP of the 6XX SERIES contains one serial communication port to support the BAG_ID_CHANNEL (serial input) and DECISION_CHANNEL (serial output).

The serial port is RS-485 standard and configured with a baud rate of 9600bps, no parity, 8 data bits, and 1 stop bit.

The CIP uses a 9-pin male D-sub connector.

The table below shows the signals and the associated connector pins.

Table 1: RS-485 Connections

Signal	D-sub Connector
Data + (B)	3
Data – (A)	8
Ground	5

Table 2: Serial Commands Summary

Command	From	Function/Notes
10-digit IATA code and 4-digit local code (or code up to 30 characters). All characters alphanumeric. All BagIDs unique across matrix	BHS	BagID
Decision	6XX SERIES	BagID + L2 decision

Referring to the Input & Output Signals listed on the following pages:

- The signals that are available even when the 6XX SERIES is in No-Scan-mode are indicated as "**Always**". These are the signals used for conveyor hand-shaking and safety.
- The signals that are available only when the scanning software is running (Scan-mode) are marked "**Scan-mode only (Remote and Local operational configurations)**".
- The 6XX SERIES has 2 PECs inside its tunnel; one near the entrance ('**Entrance PEC**') and one near the exit side ('**Exit PEC**').

7.1.1 **Input Signals**

Table 3: Commands Receivable by the 6XX from the BHS

Signal Name	Un-powered State (FALSE)	Type	Description

Signal Name	Un-powered State (FALSE)	Type	Description
BHS_RDY_SEND	N/O	Scan-mode only	Indicates the BHS input conveyor is ready to pass a bag to the machine
BHS_RDY_RCV	N/O	Scan-mode only	Indicates that the BHS output conveyor is ready to accept a bag from the machine
DECISION_ACK	N/O	Scan-mode only	Acknowledges that BHS has made note of the decision just delivered
TRANSPORT_ENABLE	N/O	Always	Indicates that BHS wishes to assume control of the machine's conveyor
TRANSPORT_FWD	N/O	Always	Indicates the conveyor should be run forward
TRANSPORT_REV	N/O	Always	Indicates the conveyor should be run reverse
ESTOP_IN	N/O	Always	Emergency stop in from the BHS E-stop circuit.
BAG_ID_CHANNEL	**Serial** (See 7.1.3)	Scan-mode only	Receives BagID over this serial communications channel

BHS_RDY_SEND:

Input to inform the machine that a bag is about to enter it for scanning. The signal should be asserted for every bag for the length of the bag.

BHS_RDY_RCV:

Input to indicate to the machine that the BHS is ready to accept a bag just scanned by the machine. This signal is available in "**Scan**" mode only.

In Scan-mode, the BHS should use the “BHS_RDY_RCV” input to control the machine’s conveyor and should keep this signal asserted to enable the conveyor and de-assert it to stop the conveyor. The machine will use this signal as part of its internal conveyor combinational control logic. Depending upon internal conditions and the state of the “BHS_RDY_RCV” signal, the machine will decide to run or stop the internal conveyor.

When the “BHS_RDY_RCV” is de-asserted and then re-asserted, the machine’s conveyor may perform a back-belt operation depending upon which mode the machine is operating in. The back-belt operation is explained in Section 0 - Dieback.

DECISION_ACK:

Input to indicate to the machine that the BHS has successfully received a decision from the machine on the DECISION_CHANNEL. This input shall be a pulse of 1 second duration.

TRANSPORT_ENABLE:

Input to indicate to the machine that the BHS wants to put the machine into “Transport-mode”.

One example of when the BHS may want to put the machine in Transport-mode is if the machine has a fault (but conveyor system is working). Hence, the BHS wants to run the machine as a conveyor (without scanning) to prevent the entire baggage line from going down

When in Transport-mode, the machine does not use any internal conditions to decide whether to run its conveyor or not. Additionally, the machine will IGNORE the state of “BHS_RDY_RCV”. It will use the “TRANSPORT_FWD” and “TRANSPORT_REV” inputs ONLY in order to control its conveyor.

The machine’s conveyor will operate as long as there is no hardware fault with the conveyor system and no E-Stop condition in the machine. The BHS should keep this signal asserted as long as it wants the “Transport” mode to be on.

TRANSPORT_FWD:

Input to indicate to the machine that the BHS wants to run its conveyor in forward direction in the Transport-mode. The BHS should keep this signal asserted as long as it wants to run the conveyor in the forward direction and de-assert it to stop the conveyor.

When “TRANSPORT_FWD” is asserted, “TRANSPORT_REV” MUST BE de-asserted.

“TRANSPORT_FWD” and “TRANSPORT_REV” both CANNOT be asserted at the same time. If BOTH are asserted at the same time when in Transport-mode, the machine will stop its conveyor.

TRANSPORT_REV:

Input to indicate to the machine that the BHS wants to run its conveyor in forward direction in the Transport-mode. The BHS should keep this signal asserted as long as it wants to run the conveyor in the reverse direction and de-assert it to stop the conveyor

When “TRANSPORT_REV” is asserted, “TRANSPORT_FWD” MUST BE de-asserted.

“TRANSPORT_FWD” and “TRANSPORT_REV” both CANNOT be asserted at the same time. If BOTH are asserted at the same time when in Transport-mode, the machine will stop its conveyor.

EMERGENCY_STOP_IN:

Emergency Stop input to machine from an external source. If the X-Rays are ON and the conveyor is running, then activating this input will switch the X-Rays OFF and stop the conveyor. This signal, a dry contact, indicates an Emergency Stop condition when it is opened and no Emergency Stop condition when it is closed. The total external loop resistance must be less than or equal to 1 ohm.

7.1.2 **Output Signals**

Table 4: Commands Sent by the 6XX SERIES to the BHS

Signal	Un-powered State (FALSE)	Type	Description
SYSTEM_ENERGISED	N/O	Always	Machine has power
SYSTEM_FAULT	N/O	Always	Machine is faulted
SYSTEM_RDY_RCV	N/O	Scan-mode only	Machine is ready to receive a bag for scanning
SYSTEM_RDY_SEND	N/O	Always	Machine ready to send a bag from 'Exit Sensor'
SYSTEM_CONV_FWD	N/O	Always	Machine conveyor is running in forward direction
SYSTEM_CONV_REV	N/O	Always	Machine conveyor is running in reverse direction
BAG_SCANNING	N/O	Scan-mode only	Machine detected bag. Requesting Bag ID from BHS
EMERGENCY_STOP_OUT	N/C	Always	E-stop signal from machine to BHS
DECISION_CHANNEL	**Serial** (See 7.1.3)	Scan-mode only	Transmits inspection decisions over this communications channel

SYSTEM_ENERGISED:

Output to indicate that the machine is powered up.

SYSTEM_FAULT:

Output to indicate that the machine is in fault condition. The fault condition could either be due to an Emergency Stop (internal or external) or an internal fault condition. When a fault occurs, a message will be displayed on the 6XX SERIES monitor screen. The machine cannot scan bags when it is in the faulted state.

Note:

In order to power-cycle the machine;

- shut down the machine safely as per the requisite procedure in the machine's operator manual
- leave the machine in a power-off state for at least 30 seconds
- restart the machine as per the requisite procedure in the machine's operator manual

SYSTEM_RDY_RCV:

Output to indicate the machine is ready to receive a bag for inspection. Some conditions when the machine may not be ready to receive bags for inspection are;

- the BHS is not ready to receive bags from the machine
- scanning software is in maintenance mode
- machine is in Transport-mode

SYSTEM_RDY_SEND:

Output to indicate the machine is ready to send out a bag. Signal is asserted for length of the bag.

BAG_SCANNING:

When the machine detects a bag, it asserts the BAG_SCANNING signal. On receipt of this signal the BHS should send a BagID to the scanner over the BAG_ID_CHANNEL.

The BagID provided by the BHS must meet the following criteria;

- The BagID shall be unique across all the machines in the same matrix environment
- The BagID shall contain only ASCII, alphanumeric characters
- The length of the BagID shall always be fixed in length (same number of characters in every BagID packet)

When the machine receives the BagID, this signal will be de-asserted. This tight "handshake" ensures the correct machine decision is attached to the proper physical bag.

If the machine does not receive any BagID or a valid BagID as per prescribed format for a bag, then the machine will auto-tag the bag with an internal ID.

The BAG_SCANNING signal is generated when the leading edge of the bag enters the X-Ray View.

It should be noted that in this mode, the 6XX SERIES may request the BHS for a BagID for a physically non-existent bag. Additionally, the machine may request multiple BagIDs for one real bag due to X-Ray On-Off sequences resulting from diebacks or excessive X-Ray noise etc. The images of all such bags detected by the machine will be sent to the Level 2 operators and their decisions will be sent back to the BHS.

EMERGENCY_STOP_OUT:

Output to indicate that an Internal (to 6XX SERIES) E-STOP has been activated.

This output will be asserted until the E-STOP has been released. The machine will then start E-STOP recovery.

An output, dry contact signal, to indicate that the E-stop on the 6xx series has been activated. The E-stop signal is always active whether the 6xx series is turned On or Off.

7.1.3 **Serial Channel Signals (Input/Output)**

BAG_ID_CHANNEL (BHS -> 6XX SERIES):

This channel is used in tight conjunction with the “BAG_SCANNING” signal to request a BagID from BHS for every bag detected by the machine.

For each bag that is scanned by the 6XX SERIES, the BHS must transmit a corresponding ID number for that bag to the 6XX SERIES. The BagID may be configured at installation for a length up to 30 ASCII characters. However, the length cannot change on a per bag basis.

The timing of the transmission of the ID number of a particular bag is critical for the machine to properly pair bag data with BagIDs. If the BHS failed to properly deliver an ID to the machine for a bag within the stipulated (configurable) timeout period, the machine automatically generates an internal ID (Auto-tag) for the bag.

With regard to the format of the Auto-tag, the length will be configured to the same length as the normal BagID sent by the BHS. The contents will be as agreed between Rapiscan and BHS company’s installation engineer but can consist only of alphanumeric characters.

Table 5 below provides further detail on these input signals.

Table 5: Standard Bag ID Packet expected by the 6XX SERIES from the BHS

Number	Content	Description	Remark	Remark
	[ASCII]		basic	extended
1	char ['A']	SOT	fixed content	
2	char ['B']	SOT	fixed content	
3	char ['C']	SOT	fixed content	
4	value [nr.1]	IATA code	variable	*
5	value [nr.2]	IATA code	variable	*
6	value [nr.3]	IATA code	variable	*
7	value [nr.4]	IATA code	variable	*
8	value [nr.5]	IATA code	variable	*
9	value [nr.6]	IATA code	variable	*
10	value [nr.7]	IATA code	variable	*
11	value [nr.8]	IATA code	variable	*
12	value [nr.9]	IATA code	variable	*
13	value [nr.10]	IATA code	variable	*
14	char ['_']	underscore	fixed content	
15	value [BCD_4]	Bag-ID	variable	msd
16	value [BCD_3]	Bag-ID	variable	
17	value [BCD_2]	Bag-ID	variable	
18	value [BCD_1]	Bag-ID	variable	lsd
19	char ['X']	EOT	fixed content	
20	char ['Y']	EOT	fixed content	
21	char ['Z']	EOT	fixed content	
22	char ['CR']	EOT	fixed content	

Number	Content	Description	Remark	Remark
23	char ['LF']	EOT	fixed content	
	(*) Only Alphanumeric characters are allowed. If code not applied then use fixed character, e.g. char[space]. **NON-ALPHANUMERIC and NULL CHARACTERS ARE NOT ALLOWED**			

DECISION_CHANNEL (6XX SERIES -> BHS):

The 6XX SERIES uses this channel to forward the screening results to the BHS.

When the operator uses the ACCEPT or REJECT button on the operator interface to issue a decision for a bag, the decision is routed back to the bag's originating machine. The machine then sends the BagID along with the operator decision to the BHS. If the Level 2 operator time-out feature is enabled and a decision is not made within the specified time-out period, then a default reject message is sent to the BHS.

The ASCII packet structure for the Decisions sent by 6XX SERIES is as follows:

<SOT><BagID><1R><2A><EOT>, where

<SOT> = Start of Transmission Character (configurable),

<EOT> = End of Transmission Character (configurable)

BagID = the exact ID received for the bag received from BHS / internally generated

1 = this field is reserved for future use (will always contain ASCII character '1', Hexadecimal 31),

R = this field is reserved for future use (will always contain ASCII character 'R', Hexadecimal 52)

2 = Level 2 Decision (in ASCII),

A = Accept (R = Reject, U = Unavailable) (in ASCII)

The Bag Result will be sent by 6XX SERIES as soon as it is available.

Note:

For a Level 2 Decision, if the operator does not make a decision within the allotted time, the 6XX SERIES can be configured to send "Operator Decision Unavailable" as "Level 2 Reject" (i.e. "2R" instead of "2U").

Table 6 below provides further detail on these output signals.

Table 6: Standard Results Packet sent by the 6XX SERIES to the BHS

Number	Content	Description	Remark	Remark
	[ASCII]		basic	extended
1	char ['A']	SOT	fixed content	
2	char ['B']	SOT	fixed content	
3	char ['C']	SOT	fixed content	
4	value [nr.1]	IATA code	variable	*
5	value [nr.2]	IATA code	variable	*
6	value [nr.3]	IATA code	variable	*
7	value [nr.4]	IATA code	variable	*
8	value [nr.5]	IATA code	variable	*
9	value [nr.6]	IATA code	variable	*
10	value [nr.7]	IATA code	variable	*
11	value [nr.8]	IATA code	variable	*
12	value [nr.9]	IATA code	variable	*
13	value [nr.10]	IATA code	variable	*
14	char ['_']	underscore	fixed content	*
15	value [BCD_4]	Bag-ID	variable	msd*
16	value [BCD_3]	Bag-ID	variable	*
17	value [BCD_2]	Bag-ID	variable	*
18	value [BCD_1]	Bag-ID	variable	lsd*
19	char ['1']	Reserved	fixed content	
20	char ['R']	Reserved	variable	
21	char ['2']	Level 2	fixed content	
22	char ['A'] / ['R'] / ['U']	Result = A/R/U	variable	

Number	Content	Description	Remark	Remark
23	char ['X']	EOT	fixed content	
24	char ['Y']	EOT	fixed content	
25	char ['Z']	EOT	fixed content	
26	char ['CR']	EOT	fixed content	
27	char ['LF']	EOT	fixed content	
	(*) The fields will be echoed back exactly as received			

8.0 Level 2 Workstation

Level 2 workstations do not interface directly with the BHS. The 6XX SERIES that scanned the bag receives the Level 2 operator decision and forwards it to the BHS.

Level 2 workstations are normally powered on except during machine maintenance. Operators use the CLEAR and REJECT buttons on the workstation console to issue inspection decisions. These buttons are only available when a bag image is on the display. Pressing one of these buttons transmits the decision from the Level 2 workstation to the originating 6XX SERIES. Then the Level 2 workstation clears the display and purges the bag image from its bag image queue.

Emergency Stops do not affect Level 2 workstations. They continue normal processing during emergency stop conditions.

9.0 Irregular Bags and Error Conditions

(1) If the machine encounters a bag greater than the maximum allowed length, the bag will be default rejected by the machine. The maximum allowed length of bag varies from model to model in the 6XX SERIES. Please refer to the appropriate model's specification sheet.

(2) Bags that are separated by less than 0.7 meters may or may not be treated as one single bag causing one or more decisions to be made for multiple bags.

(3) Bags that are side-by-side will be treated as one bag, causing only one decision to be issued.

(4) Bags with straps, buckles, tags etc. lying on the conveyor separated from the main bag may be treated as separate bags causing corrupted images and multiple decisions to be issued.

(5) Bags inserted into the 6XX SERIES must not touch the side walls of the tunnel. If bags touch the side walls, they will damage the walls and may also pivot / turn / fall off the tray, causing corrupted images in one or more Views.

(6) Bags inserted into the 6XX SERIES must not be in a condition that may cause them to move while traveling inside the machine. Some examples of such condition are bags with wheels resting on the conveyor (allowing them to roll), bags standing up on their smaller dimensions (making them easy to fall over), light bags / trays and bowling balls or bottles, which roll around easily. This list is not complete.

    If a bag moves while being scanned, it will cause corrupted images in one or more Views.

(7) The 6XX SERIES should never receive the same BagID for separate bag images. If the BHS fails to send a BagID to the machine, the machine automatically generates an Auto-tag for that bag.

(8) In addition, any items normally considered as non-conveyable by conveyor manufacturers are also to be considered as unsuitable to be passed through an inline X-ray machine. For example:

- Bicycles; Pushchairs; Wheelchairs;
- Live Animals.

NB: This list is for indication purposes only and should not be considered complete.

10.0 BHS Scenarios - Description of Operation of Signals

Note:

All signal diagrams shown in this section are to illustrate the states of the various signals. They are NOT timing diagrams and as such, are not drawn to any scale. Hence, no assumptions should be made in terms of signal and state transition timings.

Only the following BHS signals are available in Transport / No-Scan-mode:

Inputs:

- EMERGENCY_STOP_IN

Outputs:

- EMERGENCY_STOP_OUT
- SYSTEM_FAULT
- SYSTEM_CONV_FWD
- SYSTEM_CONV_REV
- SYSTEM_RDY_SEND

Operation is described on the following pages for different operating scenarios.

System Startup

After the machine is powered up, the computer/s will boot-up and the 6XX SERIES software will run and start initialization.

As part of the initialization process, the safety circuits will be enabled.

The safety circuit will be enabled ONLY AFTER

1) Operator turns the key to ON position and presses start push-button on operator console panel (human intervention) and

2) The scanning software starts up and re-enables the safety circuit.

The time taken by this process (assuming that the human intervention happens immediately when required) is up to 5 minutes.

During initialization:

SYSTEM_RDY_RCV output will be OFF (de-asserted)

The conveyor may run as part of the initialization process. The conveyor motion will be indicated appropriately by the SYSTEM_CONV_FWD and SYSTEM_CONV_REV outputs.

After the initialization is complete, the machine is ready to scan bags and the SYSTEM_RDY_RCV output is asserted.

The BHS must not send any bags to the machine for scanning until the machine is ready (SYSTEM_RDY_RCV asserted).

The above process is valid for Local as well as Remote operational configurations.

Scanning a Bag

The 6XX Series is able to scan bags when only when it is in the "**Scan-mode**".

In this mode, when a bag enters the machine's tunnel, then as the bag passes thru the X-Ray beam, the machine will detect it and request for a BagID from BHS by asserting the BAG_SCANNING output. The BagID is expected over the "BAG_ID_CHANNEL" serial input.

The BAG_SCANNING output will be de-asserted when an ID is received from BHS. If no ID is received from BHS within a time-out period, the BAG_SCANNING output will be de-asserted at the end of the time-out period and the machine will assign an internal ID to the bag.

There are 2 configurations of operation in the Scan-mode;

1. **Local Scan-mode:**

In this mode, the machine is directly connected to a local operator. The image/s of the bag screened by the machine is sent to this local operator for analysis.

In this mode, the machine conveyor is under the control of the machine (local operator) as well as the BHS. The conveyor will start / stop based on the local operator's commands as well as BHS' commands as long as there is no error / fault condition on the machine. In the case of an error / fault condition in the machine, the conveyor will stop.

The operator can stop a bag in order to look at the image for a longer time. However, he will have to give a decision before the bag reaches the exit PEC of the machine. If he does not make a decision by the time the bag reaches the exit PEC, the machine will send an "Unavailable" decision to the BHS for this bag.

2. Remote Scan-mode:

In this mode, the machine is connected to the 6XX Matrix Network with the Level 2 operators connected to the Matrix remotely to screen the bags. The image/s of the bag screened by the machine is sent to a remote operator thru the matrix. After the operator gives a decision on the bag, the decision is routed by the matrix back to the machine that scanned that particular bag.

In this mode, the machine conveyor is under the control of the BHS and will start / stop under BHS control as long as there is no error / fault condition on the machine. In the case of an error / fault condition in the machine, the conveyor will stop.

The time allowed for the Level 2 operator to make a decision is configurable and is set based upon specific installation site characteristics, such as distance of divert point from the exit of the machine, etc.

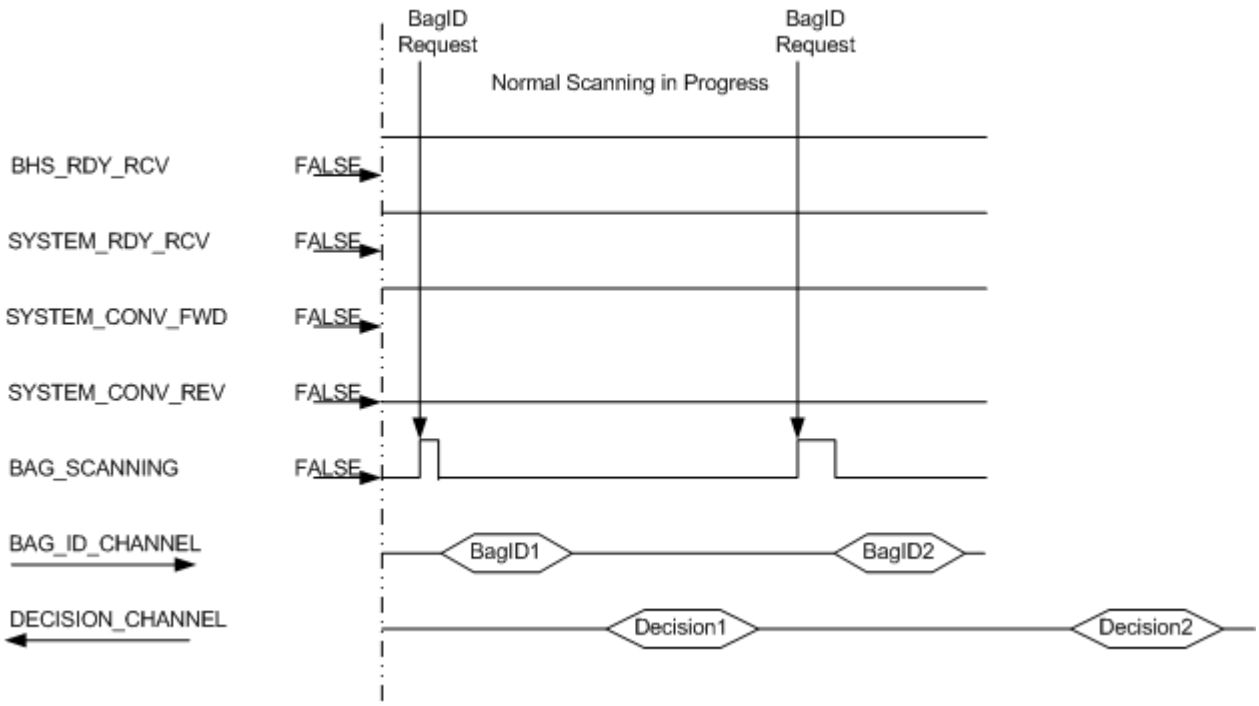
If the Level 2 operator does not make a decision in the allotted time, the machine can be configured to send either "Level 2 Reject" or "Level 2 Timeout" as the result.

In both the above configurations, the operator decision received by the machine is sent by the machine to the BHS over the DECISION_CHANNEL.

As the bag exits the machine, it passes in front of a PEC inside the machine mounted near the exit. The machine will assert the SYSTEM_RDY_SEND output for as long as the bag blocks this PEC.

Dieback operation in both modes is explained in the following section.

The signals diagram is shown below.



The dieback condition is sensed and controlled externally from the 6XX SERIES.

- **Scan-mode:** When a dieback condition is presented to the machine, the machine's conveyor is stopped and the X-Rays are switched off. When the dieback condition is cleared, the machine needs to back up the bag for a short distance (typically 150mm approx) before it can resume the scanning operation. This backing up of the conveyor is called "**back-belt**" operation. Back-belt is required by the scanning software to produce cut-free images of the bag whose scan was interrupted by the dieback.

  However, how the back-belt is performed is different depending upon which configuration the machine is running in.

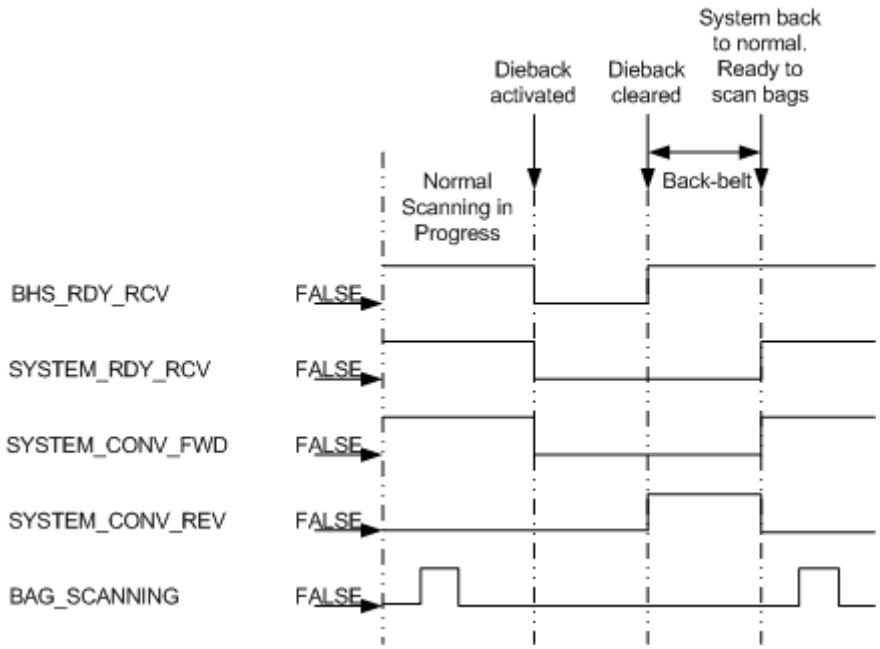
  1. **Local Scan-mode**: In this mode, when the dieback is cleared, the machine will remain in the stopped state until the operator presses the forward button on the operator panel. Once the button is pressed, the machine will perform the back-belt and then resume the scanning operation.
  2. **Remote Scan-mode**: In this mode, when the dieback is cleared, the machine will automatically perform back-belt without requiring any human intervention.

  In both cases, the machine will indicate the conveyor movement using the SYSTEM_CONV_FWD and SYSTEM_CONV_REV outputs. The BHS must use these signals to back-belt its input conveyors if necessary to ensure that the spacing between the bags being fed to the machine is maintained.

  The machine will not re-assert SYSTEM_RDY_RCV until the back-belt is complete and the conveyor forward motion is started again.

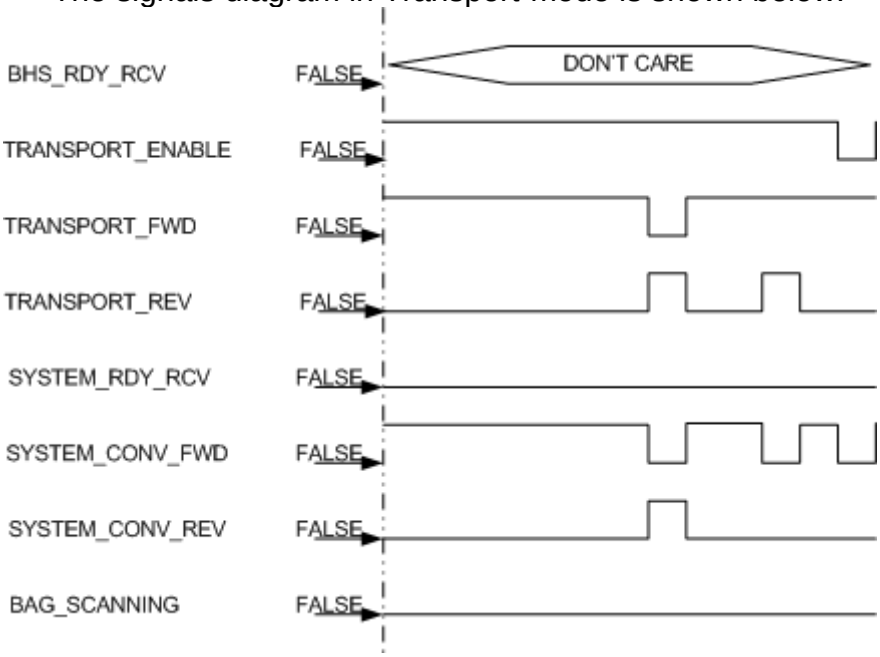
  New bags entering the tunnel after the dieback condition is cleared are scanned as normal.

The signals diagram in Scan-mode dieback condition is shown below.



- **Transport-mode:** In this mode, the machine will IGNORE the state of BHS_RDY_RCV. The machine will operate the conveyor based on Transport-mode signals only and as per the rules explained in earlier section.

  The signals diagram in Transport-mode is shown below.



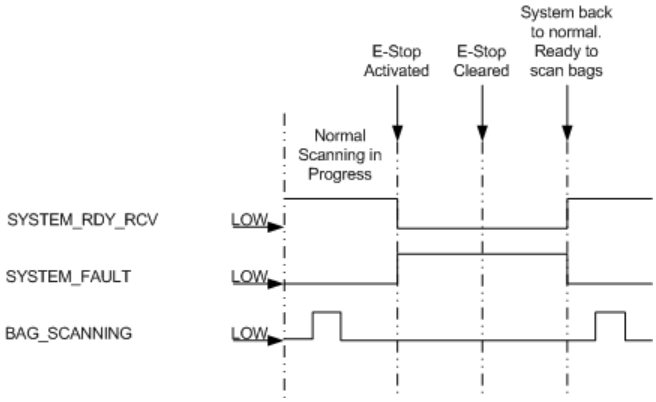
E-Stop

When an internal or external E-Stop condition occurs, the 6XX SERIES will stop its internal conveyor, irrespective of whether the machine's scanning software is running or not. If the X-Rays are ON, they will also be switched OFF.

An E-Stop condition can interrupt a bag scan. This happens due to the shutdown of X-Rays during an E-Stop. This may cause an incomplete image, and the bag is not analyzed. For fail-safe screening, all bags stopped inside the 6XX SERIES should be treated by the BHS as rejected and diverted appropriately for Level 3 inspection.

When the E-Stop condition occurs, the machine will de-assert the SYSTEM_RDY_RCV signal and assert the SYSTEM_FAULT signal. Additionally, a message will be displayed on the local screen.

The signals diagram is shown below.



If the machine's internal E-Stop is activated, EMERGENCY_STOP_OUT will be asserted.

Note: The E-stop signals to and from the machines are N/C dry contact signals. The E-stop signal from the 6xx series is always active and is not dependent whether the 6xx series is turned On or Off.

In an event of a power loss to the 6xx series, only the E-stop signal in the 6xx series is affected. The E-stop signal to the BHS will be unaffected.

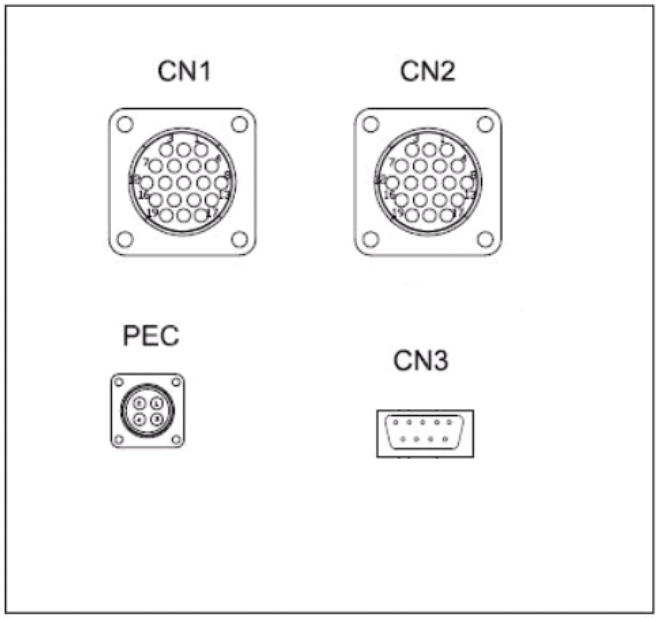
On resumption of power the safety circuit on the 6xx series will be up and running ONLY AFTER

1) Operator presses start button on console (human intervention) and

2) The scanning software starts up and re-enables the safety circuit.

After the human intervention, the time required for the machine to recover to ready state is 10 seconds

Appendix A: 6XX Series Customer Information Panel (CIP)



CN1	19-PIN CIRCULAR CONNECTOR (DRY-CONTACTS / OUTPUT CONNECTOR)
CN2	19-PIN CIRCULAR CONNECTOR (DRY-CONTACTS / OUTPUT CONNECTOR)
CN3	9P D-SUB MALE CONNECTOR (SERIAL INPUT / OUTPUT CONNECTOR)
PEC	4-PIN CIRCULAR CONNECTOR (PHOTO SENSOR POWER AND SIGNAL)

Note: "PEC" is not for BHS use. It is for machine's internal photo-cell use

Figure 3: 6XX SERIES – CIP

Appendix B: BHS Input/Output Connections

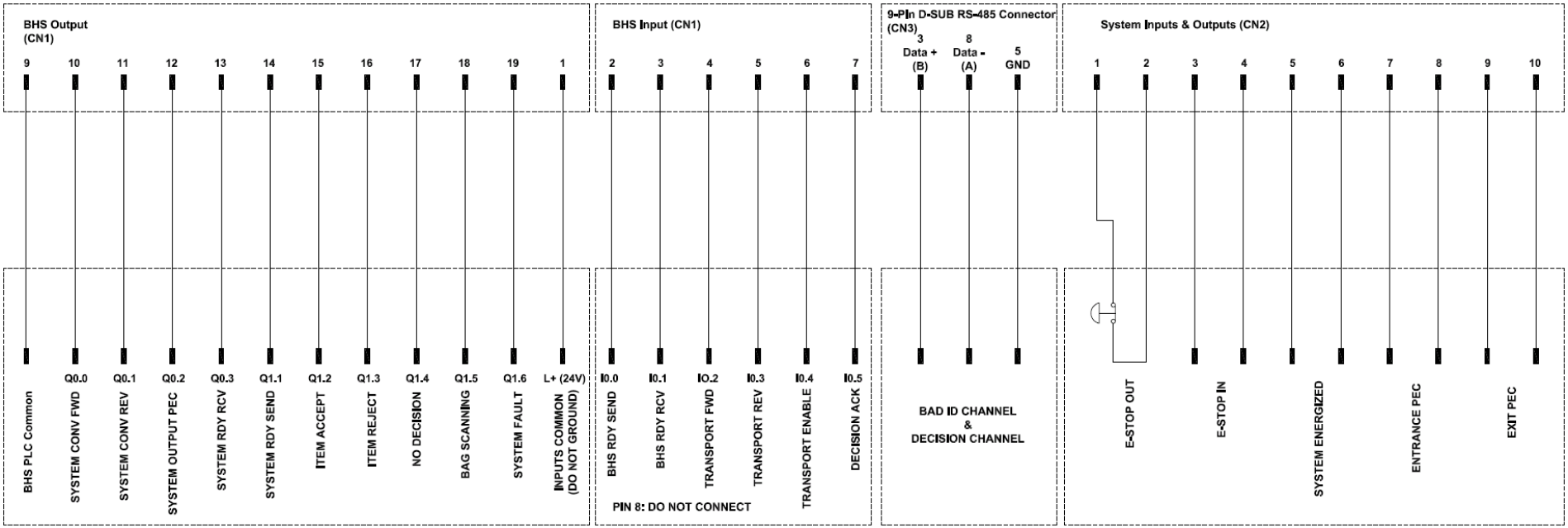


Figure 4: 6XX SERIES BHS Connections

[See next page for Table with detailed information for each CIP connection.]

Table 7: 6XX SERIES CIP – Connection Information

#	Description	Vender P/N (Rapiscan P/N)	Mating Connector Vendor P/N (if applicable)
CN1	19-Pin circular connector (Dry-contacts Input / Output connector)	Vendor: TYCO, P/Ns: Housing: 211773-1 Sockets: 166105-8	Vendor: TYCO, P/Ns: Housing: 211772-1 Pins: 66602-8 (18-14 AWG) Back-shell cover: 206512-5 Crimp-tool: 58495-1
CN2	19-Pin circular connector (Dry-contacts Input / Output connector)	Vendor: TYCO, P/Ns: Housing: 211773-1 Sockets: 166105-8	Vendor: TYCO, P/Ns: Housing: 211772-1 Pins: 66602-8 (18-14 AWG) Back-shell cover: 206512-5 Crimp-tool: 58495-1
CN3	9P D-Sub Male connector (Serial Input / Output connector)	Vendor: Data Pro, P/Ns: 1023-10C	DB9 Female RS-485 Serial Cable