Product specification
Palletizing PowerPac

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Product specification

Palletizing PowerPac

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Overview of this specification

About this product specification

It describes the performance of the Palletizing PowerPac in terms of:

- Application environment setting
- Basic concepts
- Ease of use of the software application configuration
- Interactions with peripheral equipment
- Robot operation and controls
- Software options and licenses.

Users

It is intended for:

- Product managers and Product personnel
- Sales and Marketing personnel
- Order and Customer Service personnel

References

Reference	Document Id
Application manual - Palletizing PowerPac	3HAC042340-001

Revisions

Revision	Description
-	New product specification.

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1 Welcome to Palletizing PowerPac

1.1 General

Overview

Thank you for your interest in Palletizing PowerPac. This document will give you an overview of the product characteristics and how it can be used. Palletizing PowerPac is a PC-based application software from ABB aimed at designing and running IRC5 robots in packaging and material handling applications. It will save both engineering and commissioning time in putting the palletizing process into work as well as it will save costs by reducing the amount of peripheral equipment as well as complex PLC code.

Palletizing PowerPac is used for offline configuration of palletizing applications and runtime control of PC-independent processes on the robot controller. Multiple controllers and robots can be designed in the configurator and simultaneously downloaded to connected controllers.

A palletizing cell is characterized by a robot with single or multi-head grippers, work areas used as feeding areas for pallets, products, slip sheets, and so on.

Benefits of Palletizing PowerPac

The following are the benefits of using Palletizing PowerPac:

Comprehensive application oriented software

- Configuration of palletizing lines for one or more robots
- Integrated pallet pattern generator
- Integrated expandable database for products and patterns, grippers
- Easy change or addition of new products
- Fast transfer of the application to the robots
- Integrated search functions for stack heights
- Integrated gripper library

Application Process efficiency

- Integrated fully automated station logics and cell operation (LFC) provides unrivalled high flexibility of simultaneous production of many stacks and many feeder stations, which saves costs of peripheral equipment
- Optimized robot operations on each station including pickup and place of one or more boxes at a time
- Highest robot performance through pre-fetch of next operation simultaneously with the robot motion
- PowerPac Operation Panel on the FlexPendant
- Simulation

Mimimal cost of ownership

- Standard software offering risk reduction through product-based repeat solution, configurable for a multitude of operational cases
- Globally supported by ABB

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# 1 Welcome to Palletizing PowerPac

1.1 General

Continued

- Highest enhancement flexibility through open RAPID code
- Full offline capability including full application simulation in RobotStudio

2 Introduction

2.1 Palletizing application

Overview

A palletizing application aims at picking container objects like boxes and cases from one or more stations and stack them together tightly in a second station for further shipment. An important parameter in the palletizing process is the speed of the process, that is, the throughput of products in time and the efficiency to stack the products in a stable configuration without taking too much space.
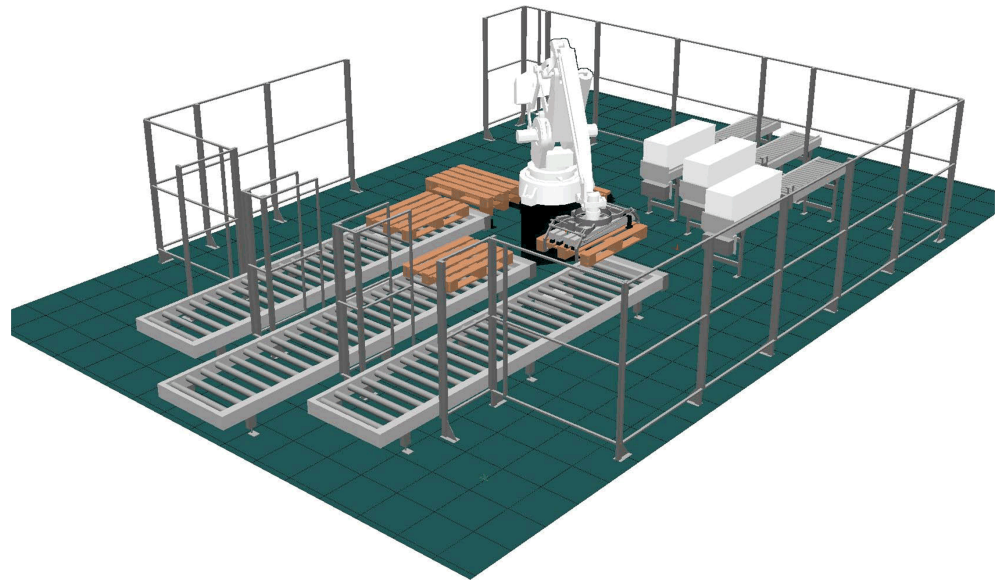
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A robot has the benefit of concentrating all palletizing to one cell where different pallet loads are produced simultaneously, for both high and low throughput demands. This makes the palletizing process flexible to adapt to different production situations. Therefore multiple infeeders and outfeeders are usually gathered around the robot, which enables parallel production of many different pallet loads. The preceding figure shows a typical palletizing cell with one robot and muliple in- and outfeeders.

2 Introduction

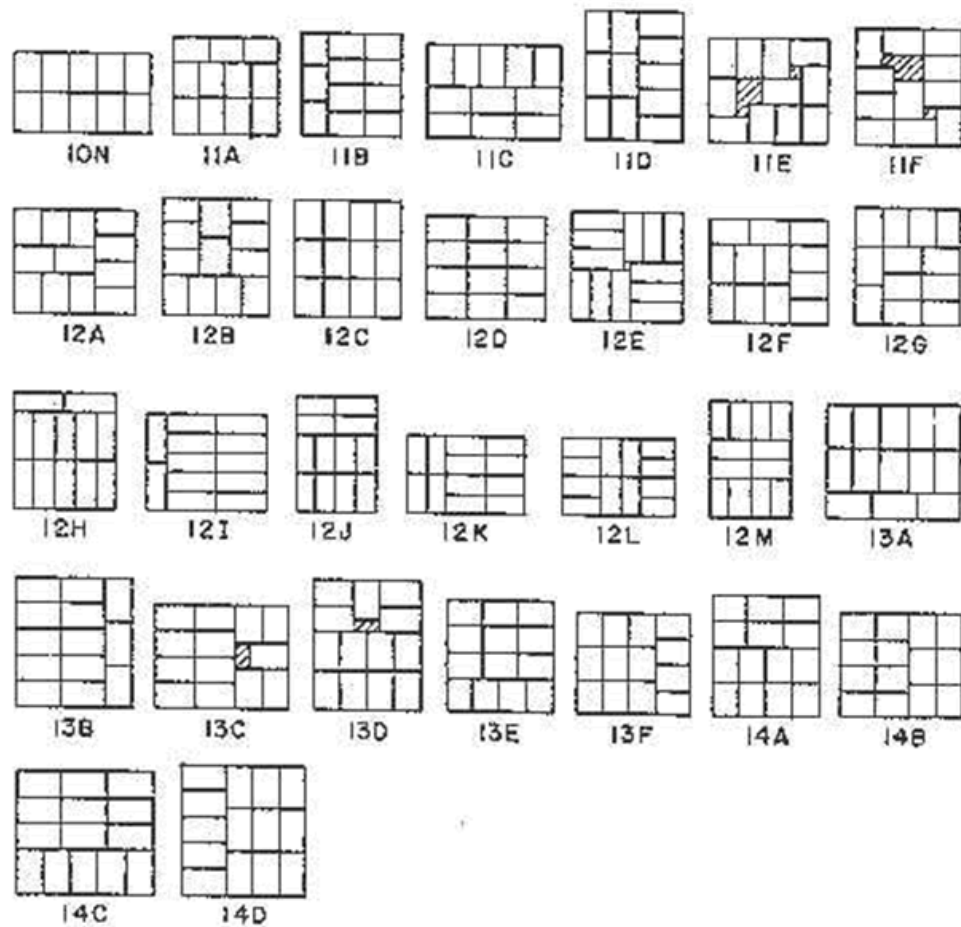## 2.1 Palletizing application

Continued

Pallet pattern layout

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Software

Palletizing PowerPac is the software, which makes the creation of a palletizing process. It is a comprehensive application oriented configuration task. One gets both the benefit of the flexibility and minimal engineering costs for programming and trouble shooting.

Feeders

Additionally, if the production can be dynamically controlled, for example allowing pallet loads and products to swap between feeders based on instant production demands, the use of the feeders can be optimized. The number of feeders can be minimized and/or the productivity can be increased, which means lower costs per produced unit.

**Logical Flow Control (LFC)**

To achieve such a high efficiency, not having to rely on a predefined setup of dedicated products and pallet loads to given stations, Palletizing PowerPac introduces an intelligent logical station control concept - the concept of "Logical Flow Control" LFC with built-in, automated intelligent order sequence control.

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LFC sends order signals to the peripheral feeder control about what product to present on each product feeder and to the robot, where to get the next products from and where to place them. This standardized LFC-concept removes the need for advanced PLC programs to control the robot palletizing cell.
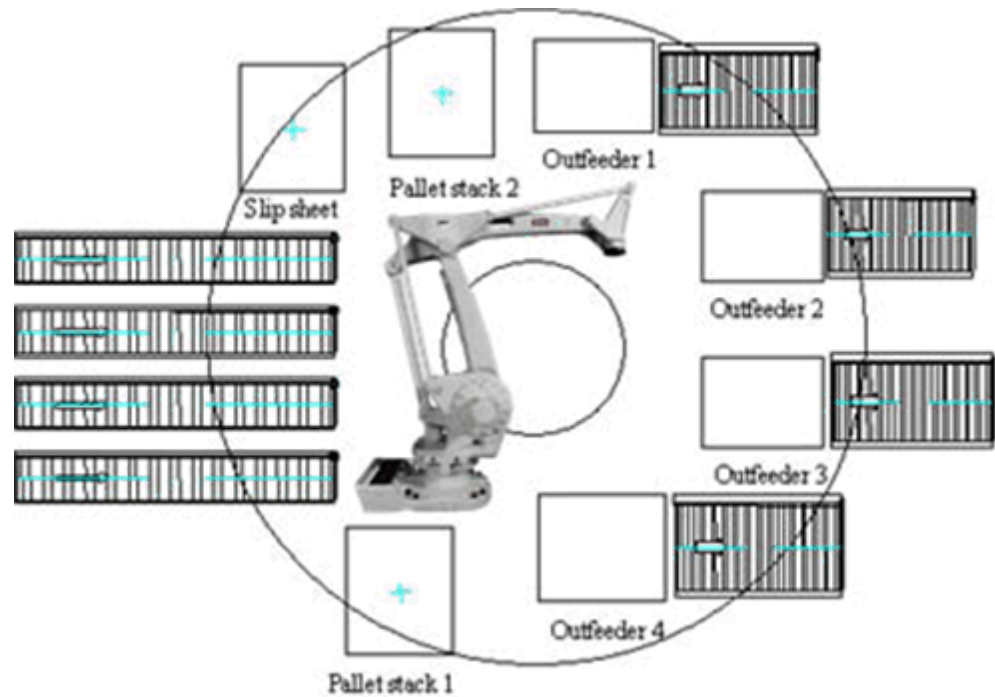
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3 System overview

3.1 Introduction

Overview

Palletizing PowerPac uses multiple hardware and software platforms to optimize the functions in each stage of the application life cycle.
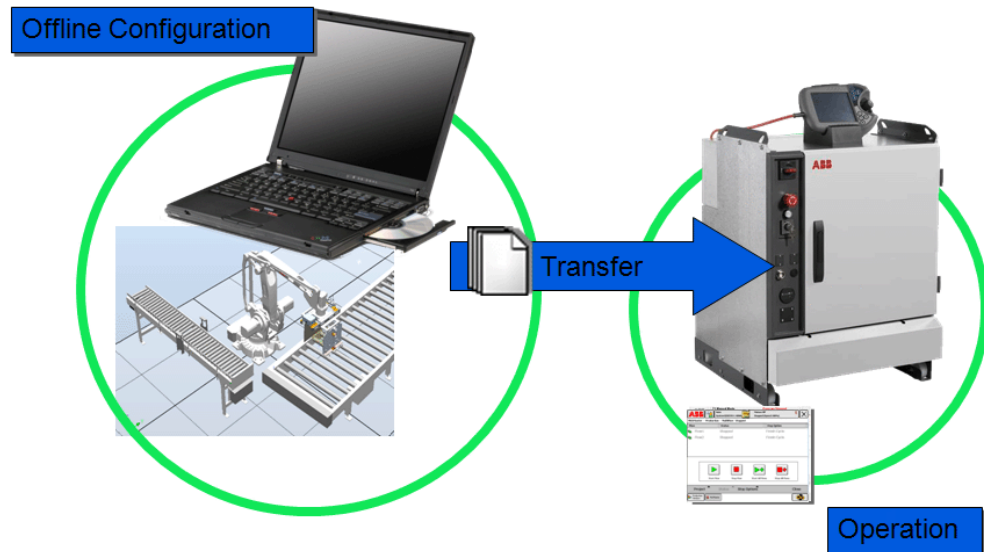
3.2 Product platforms

Introduction

Palletizing PowerPac resides on three platforms:

- Offline designer on a standard laptop PC
- Runtime execution on the IRC5 Robot Controller
- Operator's interface on IRC5 FlexPendant

xx1100000558_PalletizingPowerPacPlatforms

Further, the software is well suited for simulation in RobotStudio.

Application Design

Configuration on standard PC

A Palletizing PowerPac application is configured on a standard PC in a graphical design environment. All data including RAPID modules describing a Palletizing PowerPac application is stored in Line and Project configuration files. The result is transferred as compiled setup-files carrying all necessary information to one or more IRC5 robot controllers over ethernet.

Standard IRC5 backup function

Palletizing PowerPac projects can easily be copied between different robots using the standard IRC5 backup functions. For this purpose, to support full Palletizing PowerPac application recovery, the Palletizing PowerPac files are also transferred and stored in dedicated folders on the controller together with the setup files.

Operation

Runtime application

Once the controller is on, the runtime application starts and runs on its own without the need for a PC online (Robot Controller mode, RC-mode).

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Palletizing PowerPac operator's interface

On the FlexPendant, the Palletizing PowerPac operator's interface displays a list of all downloaded projects to select from and to start.

Commissioning work in PC application

All commissioning work, for example editing, changing, adding products is always done in the PC application. This may be done while the robot is in full operation with the PC connected to the ethernet port or completely offline. When the change is completed, simply stop the ongoing project and download the application again, select and restart.

3.3 Palletizing PowerPac

Introduction

General

Palletizing PowerPac connects in a generic way to peripheral equipment which together with robot controller and robot forms the palletizing cell. Palletizing PowerPac defines the interface names and the rules of communication with the equipment.

Interface description

Runtime signal areas

During commissioning, the application is defined and edited from the PC application and the setup files are transferred over ethernet to the controller.

In runtime, a well defined set of signals defines the communication with the stations. The following figures shows the hardware interfaces to Palletizing PowerPac.

The following runtime signal areas are supported

Runtime signal areas	Description
Gripper	open, close and idle Activators grouped in zones, which addresses one or more activators at the time. Additionally, there is a set of sensors and activator signals, which can be addressed in relation to the robot operation on a stack. This includes also search operation interfaces.
Stations	Trigger signals define the ordering and acknowledge events or products by or to Palletizing PowerPac. Group signals define the identity of individual products or product groups and the pallet loads. Further group signals define the numbers of products as well as their orientation
Execution	Triggering project launch from event connections through I/O.

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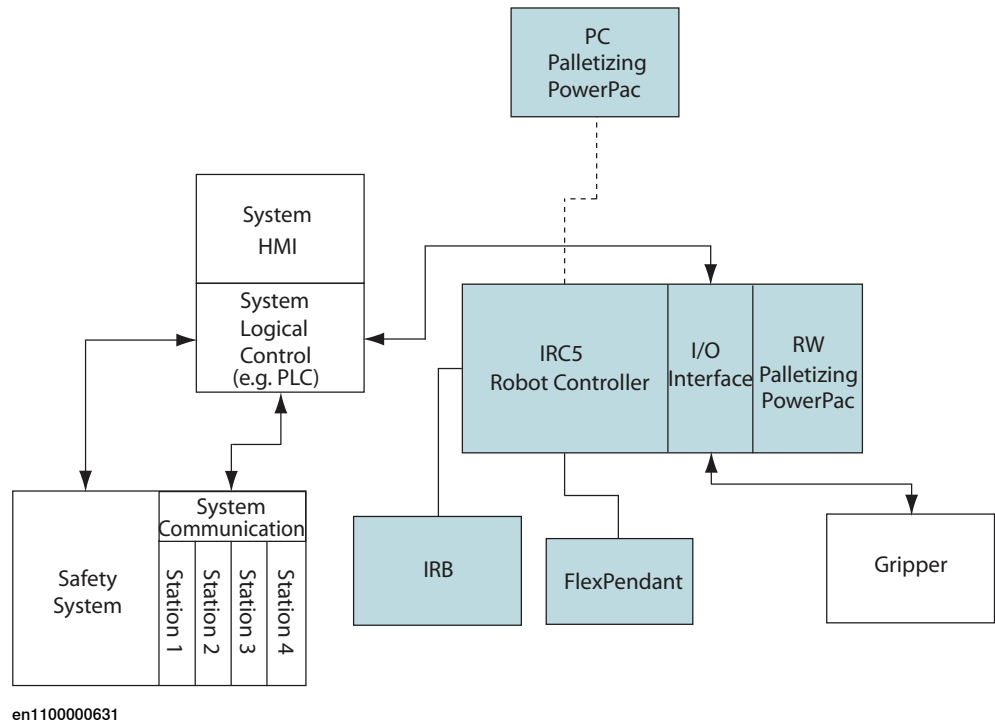
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4 Application Scope and Converage

4.1 Introduction

Application concepts

With Palletizing PowerPac, a wide variety of application concepts for both palletizing and depalletizing in a multi-feeder cell layout can be configured.

A Palletizing PowerPac application is made for controlling palletizing applications, where a robot is picking up products and placing them in defined patterns. The products are presented on feeders and they are moved to other stations, which also may be feeders. This entire process also works in reverse and refers to depalletizing

Installation description

In an installation, there are many feeders, both in and outfeeders, where the infeeders bring the products in, which shall be picked and the outfeeders are hosting the products where they are placed by the robot. A robot may be served by many infeeder and may be serving to many outfeeders.

Palletizing application

In a palletizing application, the robot is either gathering products to a specific order (palletizing) or distributing products from a specific order to product separation (depalletizing). One can say that palletizing is to create a new order of products and depalletizing to separate products from a given order.

For the robot to access the products, they need to be presented to the robot in areas, which can be reached by the robot tool. Palletizing PowerPac is able to pick up one or more product from a feeder and to place them on a second feeder according to a configured pattern.

Working positions

Palletizing PowerPac works with fixed predefined positions, which means, they have to be placed in given positions and orders. Most common use of infeeders is roll conveyors, which can push one or more products to a stop, but any other guides are possible solutions, like corner fixtures for slip sheet carriers.

Products may be presented either in one dimensional lines of multiple products side by side or piling up as stacks.

Product configuration - Format

A product configuration that can be gripped or placed in one move is called Format. A carrier may be able to present or receive different types of products, formats and patterns or stacks and it is possible to alternate between them in the same project, that is in the same production run.

4.2 Production run cases

General

The following most important palletizing operations show the flexibility of the Palletizing PowerPac process design capability. All the described combinations of pallet loads and processes may also shift dynamically between the available stations as long as the corresponding products and pallet loads are correctly allocated.

Type of pallet loads

General

It is possible to address monotype stacks of only one product type, mixed layout and even mixed product stacks. In mixed layout stacks, the same products are accumulated in different layouts per layer. In mixed product stacks, each layer needs to contain only one type of product.
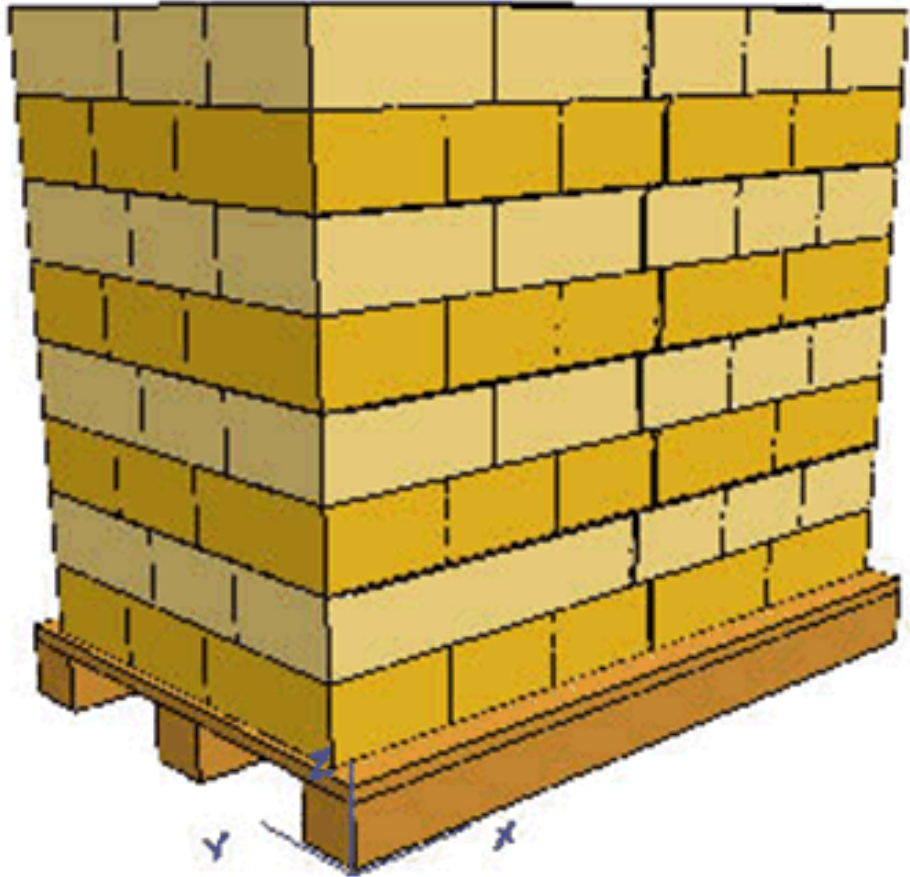
The pallet loads may be designed to include the pallet itself or only the products and complete pallet loads including the pallets may also be stacked on top of each other.

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Pallet load arrangements

Mixed layout Stack

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Slip sheets and mixed products
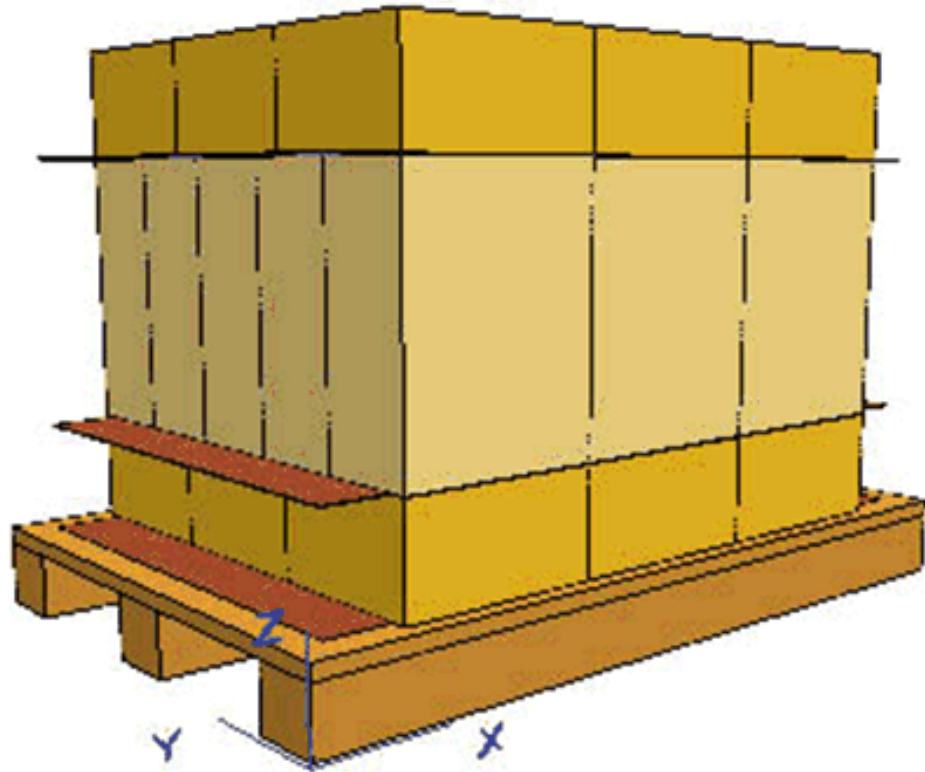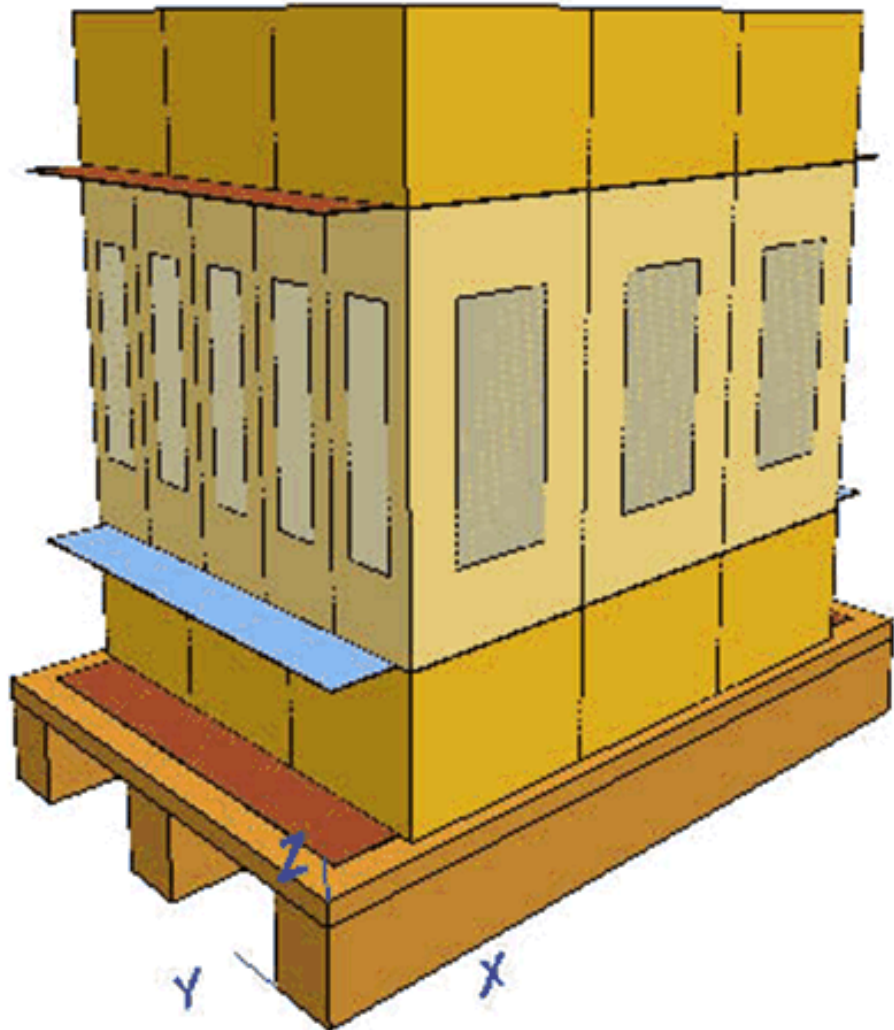

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Preferred label orientation

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Product flows

General

The product accumulation or distribution is always accomplished by the combination of three-dimensional pallet loads and one dimensional product formats. The description is showing the big variation of product tranfers or flows between feeders. The material flow directions are indicated by the arrows.

Mixed product infeed formats

One feeder may be enabled to carry one product or groups of products. The very same feeder may also carry different types of products and these different products and product formats are used to satisfy the defined order of the pallet load. This means that the formats may shift dynamically depending on the request from the pallet load.
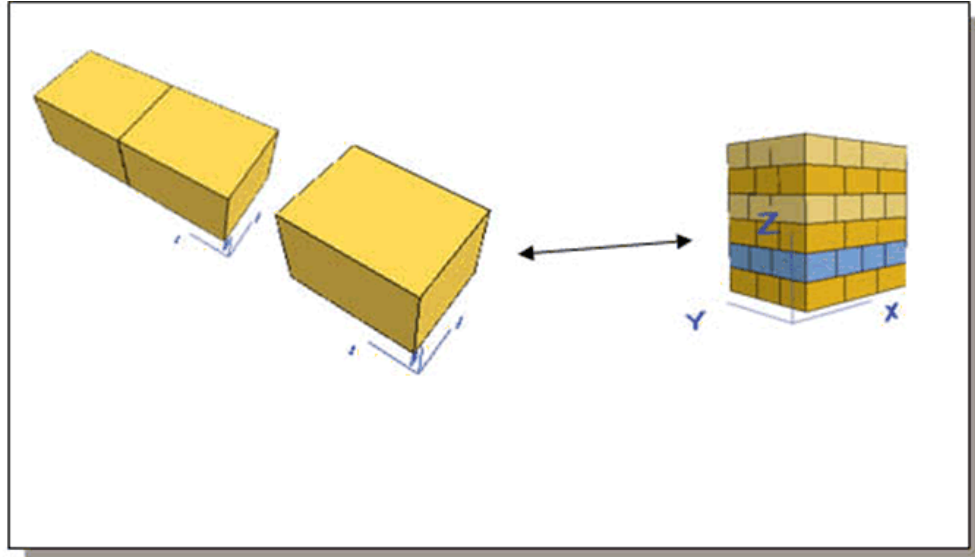
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The formats are either used to build the pallet load or they are placed by the robot when the pallet load is destacked.
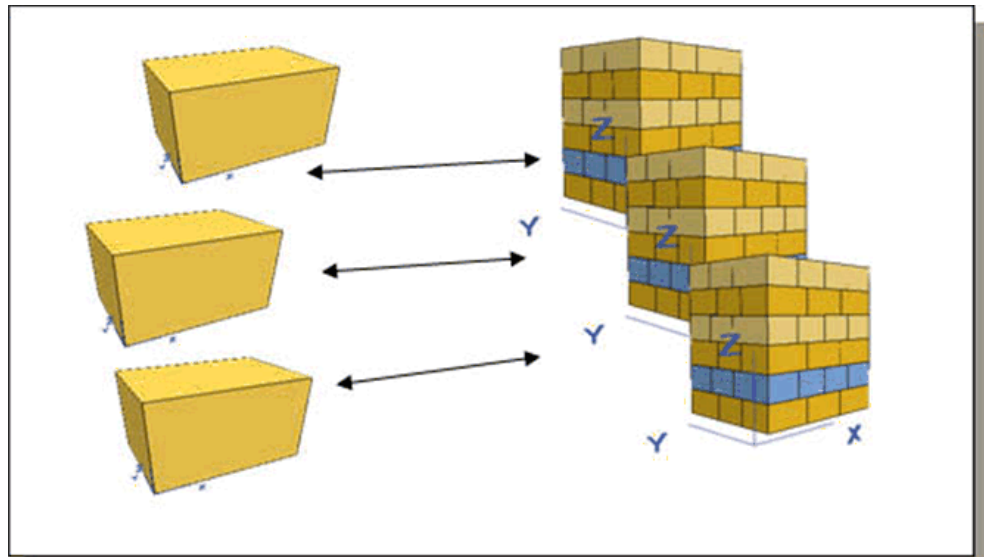
Mixed infeed formats

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One to one parallel production with separated in- and outfeeders

Parallel production of product feeders and pallet stations for simplifying the product flow and reducing complexity.

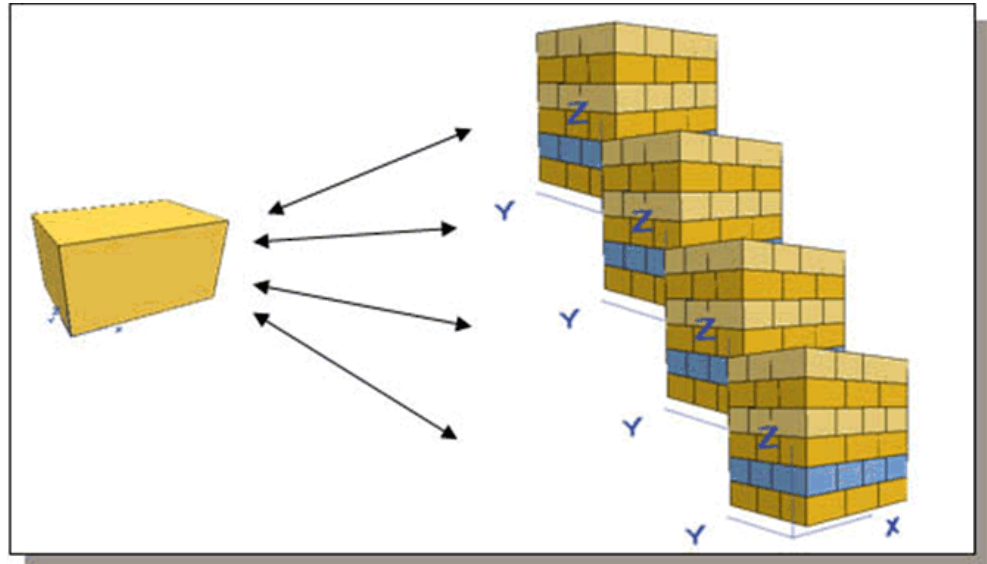**Mixing of multiple products to one stack**

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Product distribution to multiple production stations

One feeder is used to serve multiple pallet stations. This is the case when a specific product is only presented on one feeder, but used by more than one stack. It is the same flow as when slip sheets or pallets are distributed from one stack to multiple pallet loads.

Product distribution to multiple pallet stations

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4.2 Production run cases

Continued

Mixing of multiple products to one stack

When different products are combined from multiple infeeders to one pallet load, this represents a mixing of products. It might sometimes also be the same product presented on different feeders in order to overcome long time delays for transporting the products to their presentation position. The first feeder that is ready will then be selected.
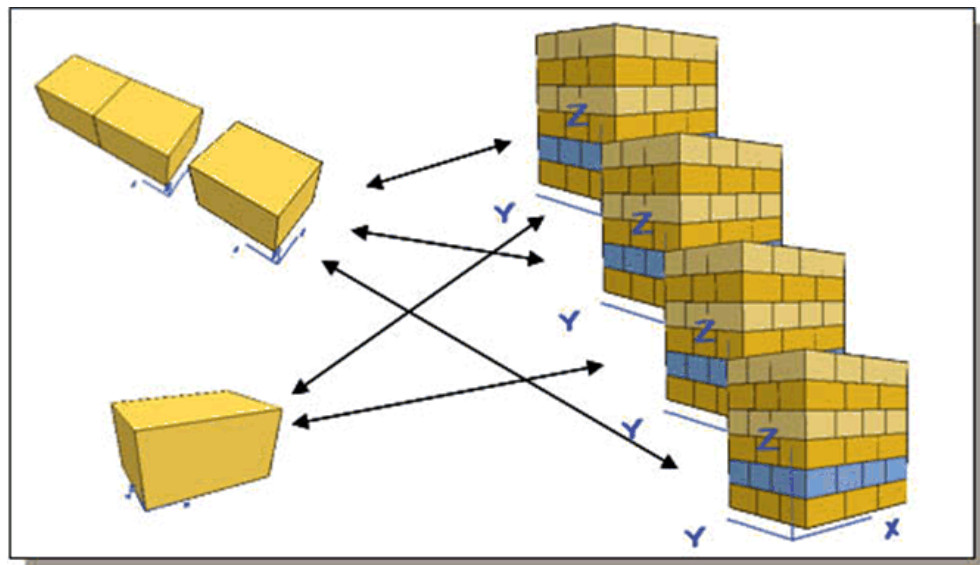
Mixing of multiple products to one stack
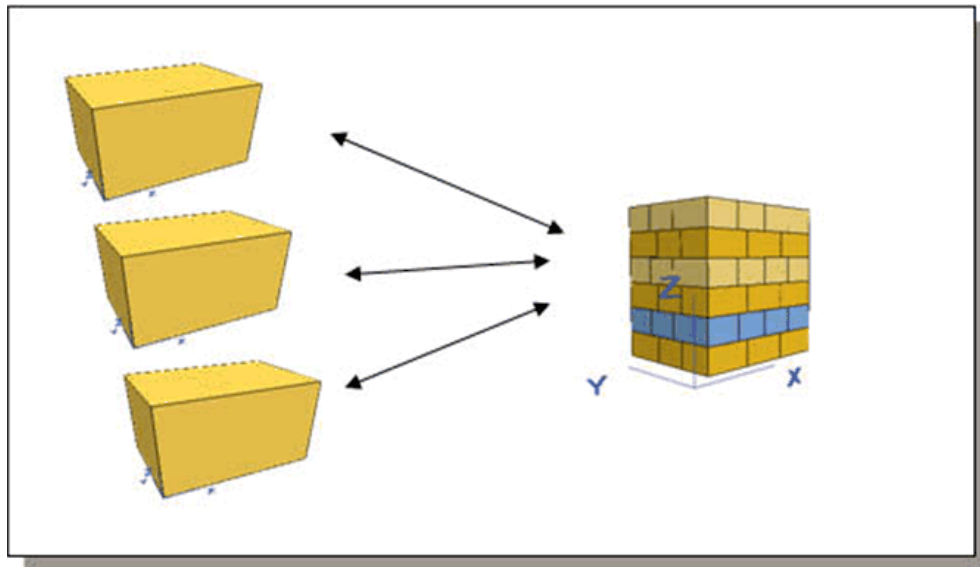
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Combination of concepts

All above flow descriptions may be combined and changed dynamically without restarting a project.

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5 Software concepts in Palletizing PowerPac

5.1 Introduction

General

Palletizing PowerPac is made for smart and effortless configuration of palletizing applications without the immediate need for functional and conceptual programming of the robot. The application oriented configuration concept solves a wide variety of application cases without the need for programming RAPID code.

This makes Palletizing PowerPac the ideal tool for many material handling applications where material is moved between stations.

Palletizing PowerPac supporting tools

Palletizing PowerPac contains tools for supporting the entire process from design and description of equipment, as well as product and pallet loads, to the calculations of optimal robot operations and dynamic station logics. The Palletizing PowerPac configuration is defined as user oriented application information, which is translated and understood as elements of a robotic movements and process interaction.

Source code template concept

The product covers a wide variety of typical cases and additionally secures full freedom of design and late adaptions in RAPID through a flexible open source code template concept.
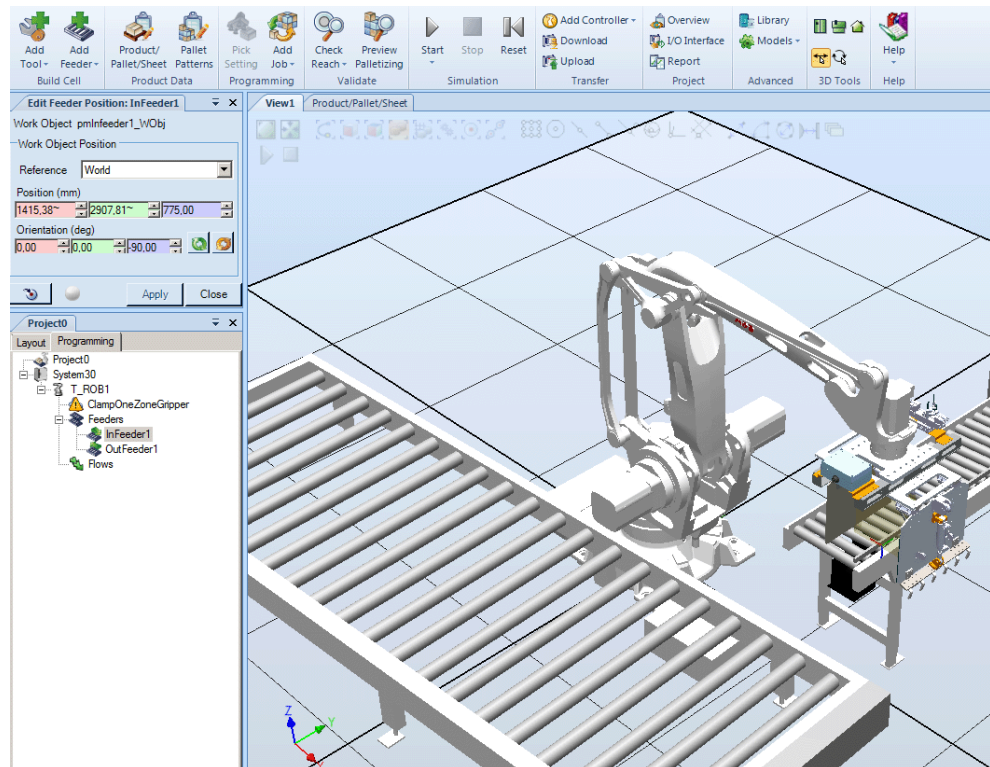
5.2 Description of software concepts

Introduction

General

The application is stored on the PC in XML standard and may easily be transferred from one system to another. The following figure shows the project view.

xx1100000559_PalletizingPowerPacProjectView

Controllers connected to Palletizing PowerPac

A maximum of 32 IRC5 controllers may be connected simultaneously to Palletizing PowerPac. Palletizing PowerPac supports all 4 and 6 axes ABB robots.

Task oriented definitions

With Palletizing PowerPac the application is designed using the description of objects taking part in the process. The parameters describing the objects are used for influencing the process itself. Attributes like maximum allowable acceleration and speed are defined with each product and they limit the motion acceleration and speed of the robot when they are carried in the gripper.

Separation of geometry and process

The process components and result are described independently of the robot influence. In a second step they are combined with the robot placement, reach and so on, which automates the sequences of picking up one or more products and placing them in one or more steps.

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The indepedency of the geometry makes this part of the application description a generic one and therefore, other descriptions of products and pallet loads can easily be imported into the Palletizing PowerPac form from other pallet load sources like 3rd party software or databases.

Flexible Gripper integration

Grippers are described in a generic way leaving it open to choose vacuum cup or mechanical arm grippers with sensors and to coordinate them with the robot motion and process. There is also a library with ABB grippers ready to be used.

Generic Station concept

All stations in Palletizing PowerPac may be defined as in-, outfeeders or stack search stations. Palletizing PowerPac defines a very generic interface concept with the stations leaving the details of how to accomplish certain formation completely open to the peripheral equipment control.

Each controller may define maximum 15 work areas or stations.

Pattern generator, selector and editor

Patterns may be either selected from a database or calculated in a number of alternatives based on available palletizing areas and product shape.

Database

A database is included for hosting predefined and new shapes, pallet patterns and grippers. The database can easily be used by other lines and projects.

Online/offline definitions

The Palletizing PowerPac application may be defined completely offline or online with one or more controllers connected. Definitions in the controller, for example user frames, I/O signals and TCPs are selected in Palletizing PowerPac. New definitions are made with the standard tools like in Robot Studio or on the FlexPendant.

Bi-directional process execution

Process execution and operations are easily inverted, which enables easy switching between palletizing and depalletizing.
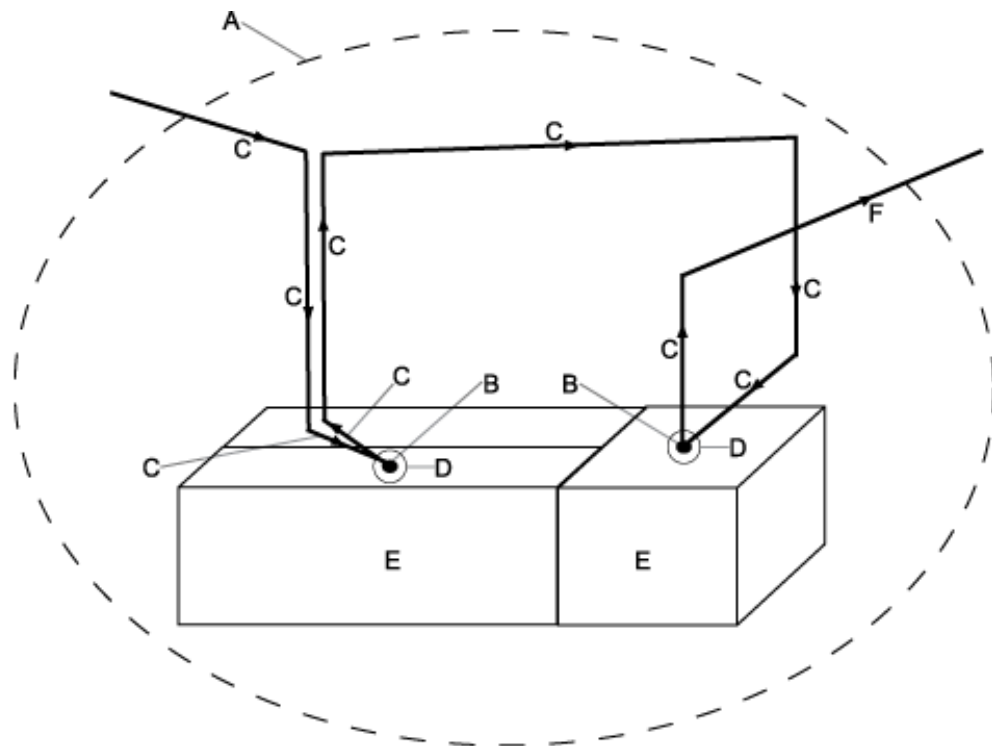
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Parametrized Path

Palletizing PowerPac automatically calculates the optimal path for each stack and format. The result is defined as a parameters feeding data for a generic motion sequence.

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Pos	Description
A	Operation
B	Targets
C	Actions
D	Event (in this case Turn off the vacuum)
E	Products
F	To next InterMid position

When applying automatic stack searching, a special search sequence will apply for finding the height of the stack, for feeding back the calculated number of layers, which may also be repeated periodically after a number of layers.

Logical Flow Control - LFC

Palletizing PowerPac contains an integrated process sequence logics based on the concept named Logical Flow Control LFC, which enables a high flexibility for dynamically mixing products and pallet loads with a minimum of hardware cost and commissioning effort.

LFC is controlling the selection of pallet loads and product feeders at any time, thus preparing the process of providing products just in time for the robot to be ready to access before the prior operation was completed.

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Running a Palletizing PowerPac project means starting the flow concept and independently of that to launch the Robot Program.

A flow is described as containing one Master station and one or more slave stations. The master station dictates the product feeding on the slave stations. Flows may operate in parallel and a configurable priority concept controls the order of the master access.

With the Logical Flow Control concept, the user may instantly change a feeder for a product or a pallet load, thus making the installation very flexible and cost efficient. This means that LFC includes the ability to prepare products for showing up dynamically on different feeders.

RAPID Templates

RAPID modules are selected and saved with the Palletizing PowerPac project. They may be downloaded with the project, but it is also possible to keep modules on the controller independently of the downloading of the projects. The RAPID code may be edited on the FlexPedant or on the PC and the result may be uploaded into the application again.

The RAPID needs only very little code for interacting with the Palletizing PowerPac project where the complexity of the sequences and the target datas are hidden. The RAPID code does only need to execute simple generic loop code to ask the flow, operations, targets, and so on for data to be used in generic move instructions.

The RAPID code is not generated or influenced directly by Palletizing PowerPac. This means that a Palletizing PowerPac palletizing process can easily interact with any RAPID code and other applications

Ordering a Production

Palletizing PowerPac defines where pallet loads and products may be presented. In runtime, Palletizing PowerPac only starts the project and the flows, which enables production on the appointed stations.

The decision to execute a specific pallet load is coming from the user's ordering system, setting the corresponding group signals on the appointed station.

Palletizing PowerPac then directs the peripheral equipment to direct the correct products to the feeders to satisfy the pallet load's need

Simulation

The configured palletizing cell can be simulated in runtime in the PowerPac. Exact cycle time with gripper settings is based on continuous access off products to be picked.

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6 Features

6.1 Operation

Introduction

The Palletizing PowerPac run time process is entirely located on the IRC5 robot controller for self-contained launch and operation. All application data is stored in the setup files which were transferred from the PC configurator.

The application is launched from the Palletizing PowerPac operator's interface on the FlexPendant.

Open RAPID code is interacting with the built-in application leaving many openings to enhanced proprietary variations to the preinstalled default templates.

The integrated application solution takes care of the preparation of all execution data and the timely control of the stations.

The Palletizing PowerPac user code uses dedicated data, functions and instructions to extract relevant information and to execute the simplest instruction loop with the robot move instructions.

Application control

The application is selected and launched from the Palletizing PowerPac interface on the FlexPendant. The operation is started by starting the flows all together or one at the time individually.

It is also possible to launch an application by a RAPID instruction, which can be connected to an I/O signal for remote control from a line controlling system. In this case the flows shall be configured for automatic launch.

The RAPID execution may be stopped and restarted at any time without loosing application data. The application will also persist when the Program Pointer is reset to Main. The application will adapt to the status of the interrupted ongoing operation and resume from there.

Operator's panel on FlexPendant

The Operator panel has the following windows:

- Project selection
- Project start/stop and Flow start/stop
- I/O Signals
- Application status

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7 Technical Specifications

7.1 Product Content

Software Package

The PC software is delivered on a CD as an option. It may also be downloaded from the ABB Product site.

Licenses

Palletizing PowerPac is an add-in to RobotStudio, which uses a node-locked license key that is locked to a certain PC and is only available for the user of that PC.

Requirements and Limitations

Palletizing PowerPac works with the IRC5 robot controller and RobotWare 5.14 or higher. It is approved for working on all IRB types.

The PC application is verified on Windows 7.

Palletizing PowerPac is not approved for running in a MultiMove configuration.

A maximum of 15 stationary work areas are possible per robot controller.

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8 Specification of Variants and Options

8.1 Palletizing PowerPac options

General

Palletizing PowerPac consists of the PC software and the RobotWare options on the IRC5 controller. The PC software is licensed per PC, which makes it able to interface any IRC5 controller that is configured with the *Prepared for Palletizing* option.

The delivery content of a PC software license is an electronic license certificate document.

Palletizing PowerPac related Controller Options

The following options need to be ordered for the IRC5 robot controller operating with Palletizing PowerPac. See also the related robot controller product specification.

RobotWare Option

Option	Description
642-2 Prepared for Palletizing	Each robot operating with Palletizing PowerPac requires the option *Prepared for Palletizing* on the IRC5 robot controller. The option contains all necessary functions to interface Palletizing PowerPac.
	This option does not work together with MultiMove (604-1 or 604-2) and Conveyor Tracking (606-1)

Hardware options

Option	Description
716-1 VDC or 717-1 AD Combi	At least one digital I/O board or similar is required for exchanging signals between Palletizing PowerPac and the robot controller. See hardware description for the number of signals required.

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