TNPSC CTSE - 2025
DIPLOMA LEVEL

INDUSTRIAL ROBOTICS AND DIGITAL MANUFACTURING TECHNICIAN

POST CODE: 3629

SUBJECT CODE: 538

TEACH PENDANT

- **The teach pendant is a handheld device used to program, control, and monitor industrial robots.**
- **It allows operators to manually "teach" positions and motions to the robot and execute or debug programs safely.**
- **The teach pendant for an industrial robot allows an operator to manually control the robot's movements and program its actions through a teach-and-repeat method.**
- **The front typically houses controls like a joystick or keypad for navigation, along with a display screen showing robot commands and menus.**
- **The back often includes an emergency stop button and a "dead man's switch" for safety.**

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TEACH PENDANT

Front Side of the Teach Pendant (Operator Interface Side)

- **The front panel is the primary user interface, containing screens, buttons, and controls.**

✅ 1. Display Screen (Touch or Non-Touch)

- Function: Shows robot status, coordinates, program code, alarms, and menus.

- May be touch-enabled or navigated using arrow keys.

✅ 2. Navigation Keys / Cursor Keys

- Function: Used to move through menus, select options, or edit lines of code.

TEACH PENDANT

Front Side of the Teach Pendant (Operator Interface Side)

✅ **3. Jog Keys or Joystick**

- **Function**: Move robot joints or tool manually (one axis at a time).

- **Modes**: Joint, Cartesian (X, Y, Z), Tool, or World.

✅ **4. Soft Keys / Function Keys**

- Located below the screen or on the sides.

- **Function**: Context-sensitive functions (like Save, Run, Back, etc.).

✅ **5. Emergency Stop Button (E-Stop)**

- **Function**: Immediately stops all robot motion and disables servos.

- Safety-critical; large and usually red/yellow in color.

Robot Teaching Pendant

Perceptual intuition operation interface
Users can directly understand operations via icons displays

Large window
High definition color screen
6.5-inch color LCD display

Using function keys realizes simple operations
Rapid teaching program can be carried out by function button

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TEACH PENDANT

Front Side of the Teach Pendant (Operator Interface Side)

☑ **6. Enable/Deadman Switch**

- A safety switch (held by the operator) that **must be pressed to allow motion.**

- If released, all motion stops immediately.

☑ **7. Mode Selector Switch**

- Function: Switches between:

    - **Teach Mode** (manual programming)

    - **Play/Auto Mode** (automatic execution)

    - **Test Mode** (debugging)

☑ **8. Control Buttons**

- **Start, Stop, Reset, Hold, and Step**

- Used to run or step through robot programs.

TEACH PENDANT

Back Side of the Teach Pendant
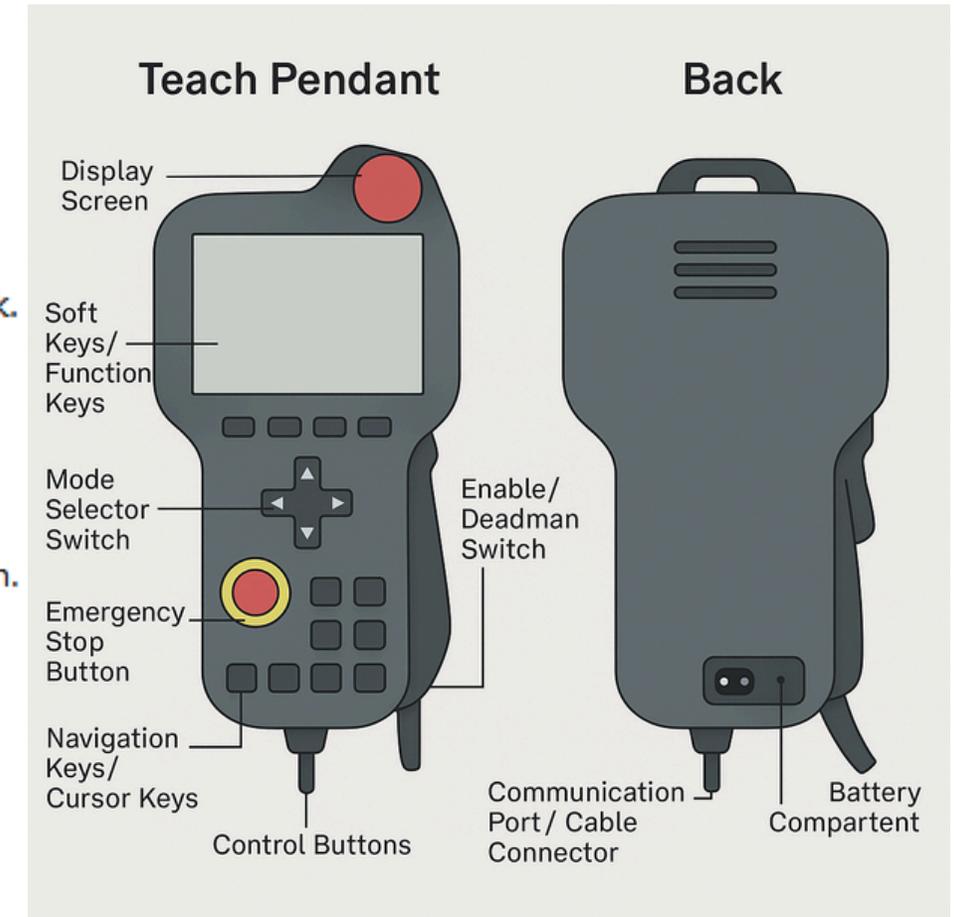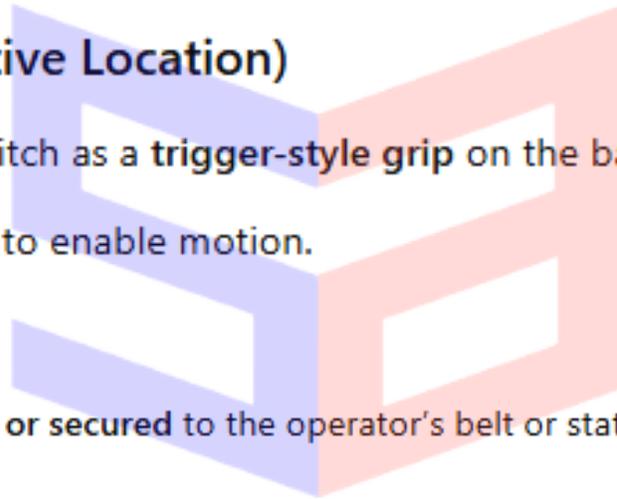
✅ **1. Deadman Switch (Alternative Location)**

- Some models have the deadman switch as a **trigger-style grip** on the back.

- Must be held in the middle position to enable motion.

✅ **2. Belt Clip or Strap Hook**

- **Function:** Allows the pendant to be **hung or secured** to the operator's belt or station.

✅ **3. Ventilation Slots**

- **Function:** Passive cooling of internal electronics.

Teach Pendant — Back

- Display Screen
- Soft Keys/ Function Keys
- Mode Selector Switch
- Emergency Stop Button
- Navigation Keys/ Cursor Keys
- Control Buttons
- Enable/ Deadman Switch
- Communication Port / Cable Connector
- Battery Compartent

TEACH PENDANT

Back Side of the Teach Pendant

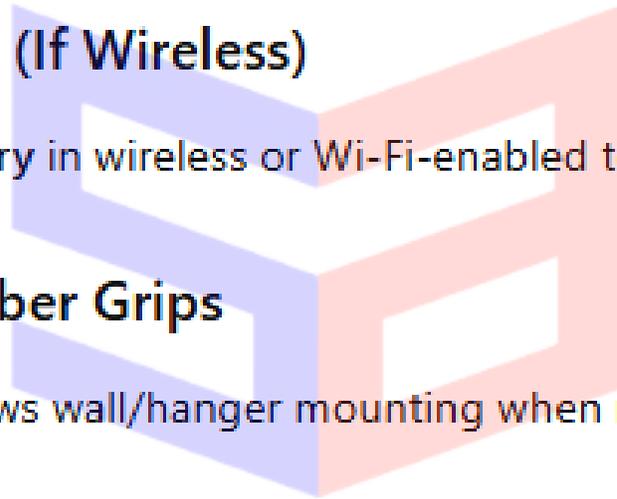✅ **4. Battery Compartment (If Wireless)**

- Houses the **rechargeable battery** in wireless or Wi-Fi-enabled teach pendants.

✅ **5. Mounting Slot or Rubber Grips**

- **Function:** Improves grip or allows wall/hanger mounting when not in use.

✅ **6. Communication Port / Cable Connector**

- May route through the back of the pendant.

- **Function:** Connects to the robot controller (for data and power).

TOOL COORDINATE SYSTEM

- **The Tool Coordinate System (TCS) is a key concept in industrial robotics, used to define the position and orientation of the tool (e.g., gripper, welder, drill) attached to the robot's end-effector.**

- **It plays a crucial role in path planning, precision control, and programming.**

- **The Tool Coordinate System is a local coordinate frame attached to the robot's tool center point (TCP).**

- **It moves with the tool and defines the X, Y, Z directions relative to the tool itself, not the robot base.**
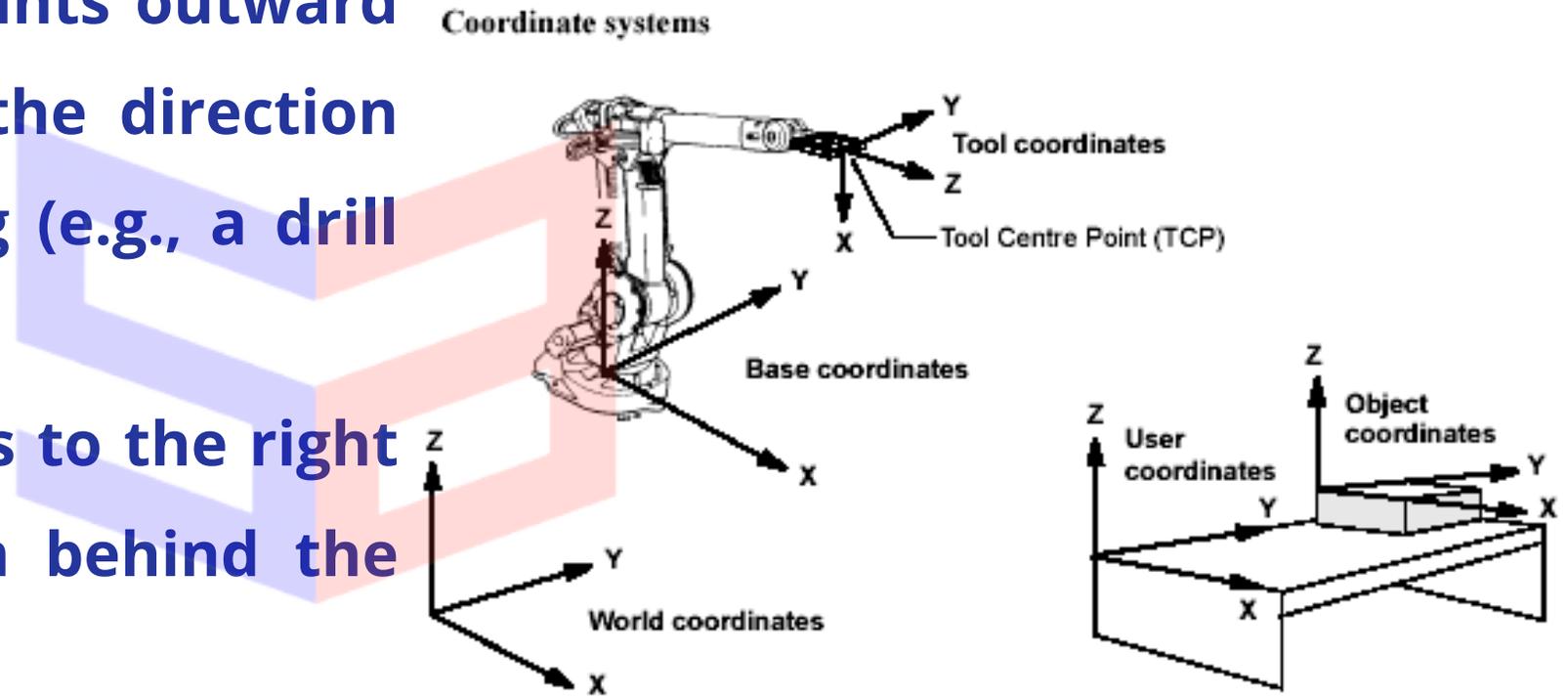
TOOL COORDINATE SYSTEM

Axes of the Tool Coordinate System

- **Z-axis:** Typically points outward from the tool, in the direction the tool is working (e.g., a drill points in Z+).

- **X-axis:** Often points to the right when viewed from behind the tool.

- **Y-axis:** Completes the right-handed coordinate system.

Coordinate systems

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TOOL COORDINATE SYSTEM

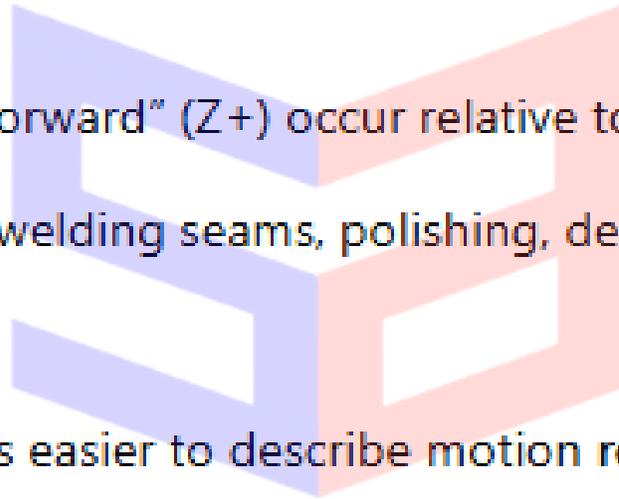## Why Use the Tool Coordinate System?

1. **Accurate Tool Control:**

   - Movements like "move forward" (Z+) occur relative to the tool tip.

   - Especially important for welding seams, polishing, deburring, etc.

2. **Simplified Programming:**

   - When teaching paths, it's easier to describe motion **relative to the tool** rather than the robot's global base.

3. **Consistent Motion Across Workpieces:**

   - Tool paths remain valid even if the workpiece is repositioned.

TOOL COORDINATE SYSTEM

Feature	Tool Coordinate System (TCS)	Base Coordinate System (BCS)
Origin	Tool Center Point (TCP)	Robot base or workcell origin
Moves with robot?	✅ Yes	❌ No
Used for?	Tool programming & control	Positioning of objects, fixtures
Example Use	Welding direction	Moving to part loading station

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TOOL COORDINATE SYSTEM

Setting the Tool Coordinate System (Calibration)

1. **4-Point Method / 6-Point Method:**

   - Touch the same point in space from different angles.

   - The controller calculates the TCS from these inputs.

2. **Manual Entry:**

   - Enter TCP offset and tool angles manually (based on CAD or measurement).

3. **Laser or Calibration Jig:**

   - For high precision tasks, tools like laser pointers or calibration fixtures are used.

USER INTERFACE

- The User Interface (UI) of a Teach Pendant in industrial robotics is designed to provide intuitive and precise control of a robot.

- It allows operators to teach positions, program actions, control movement, and monitor robot status—all from a portable handheld device.

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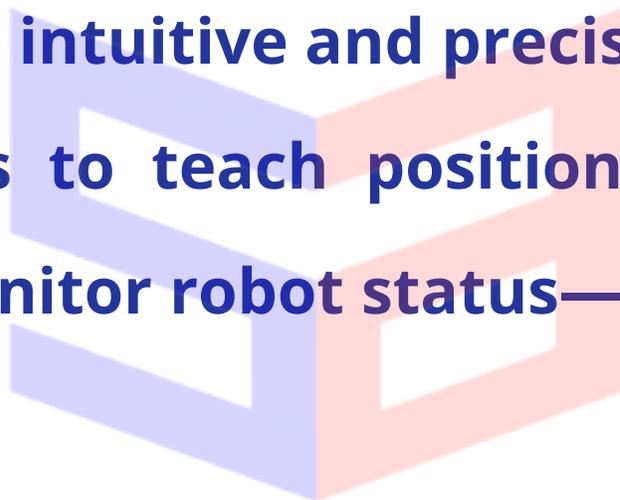
USER INTERFACE

Main Components of the Teach Pendant UI

1. Display Screen (Touchscreen or Non-Touch)

- **Function:** Shows menus, program code, robot status, error messages, positions, IO signals.

- **UI Elements:**

    - **Main Menu:** Access programming, configuration, alarms.

    - **Status Bar:** Displays current mode, tool, coordinates, speed override.

    - **Program Editor:** View/write robot programs in structured text or block format.

    - **Position Window:** Shows Cartesian, joint, or tool coordinates.

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USER INTERFACE

Main Components of the Teach Pendant UI

2. Soft Keys (Function Keys)

- Located below or beside the screen; their function changes based on screen context.

- Examples: `Edit`, `Save`, `Run`, `Next`, `Back`, `Tool`, `Coordinate System`.

3. Navigation & Cursor Keys

- Used to scroll through menu items or move within program lines when touchscreen is unavailable.
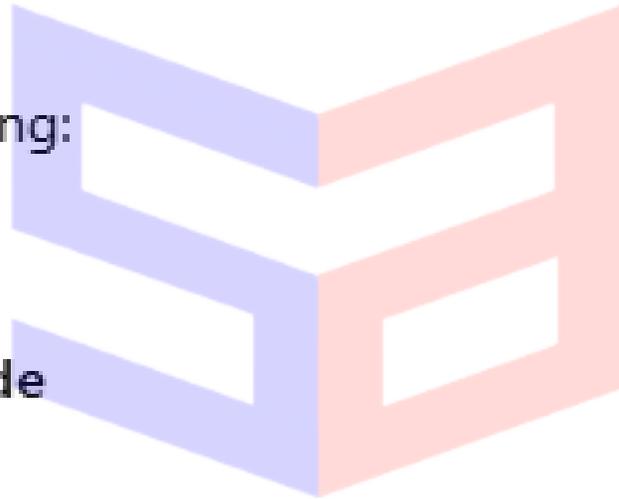
USER INTERFACE

Main Components of the Teach Pendant UI

4. Jogging Interface

- UI to jog the robot using:

  - Joint mode

  - World (base) mode

  - Tool mode

  - User frame mode

- May include toggles for step vs continuous motion.
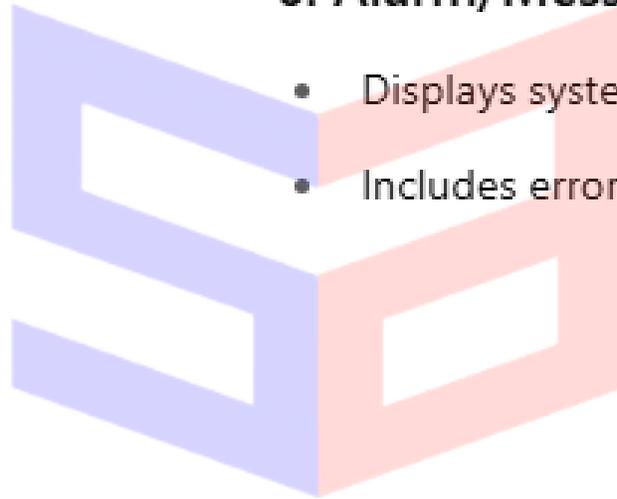
USER INTERFACE

Main Components of the Teach Pendant UI

5. Programming Interface

- Modes:

  - Point-to-point motion

  - Linear motion

  - Circular motion

- Instruction Types:

  - Movement commands (`MoveJ` , `MoveL`)

  - IO commands (`SetOutput` , `WaitInput`)

  - Logic (`IF` , `WHILE` , `GOTO`)

- **Pop-up menus** for instruction selection and modification.

6. Alarm/Message Log

- Displays system errors, warnings, or status updates.

- Includes error codes, descriptions, and troubleshooting hints.

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USER INTERFACE

Main Components of the Teach Pendant UI

🔒 Safety and Control Interface

7. Emergency Stop Status

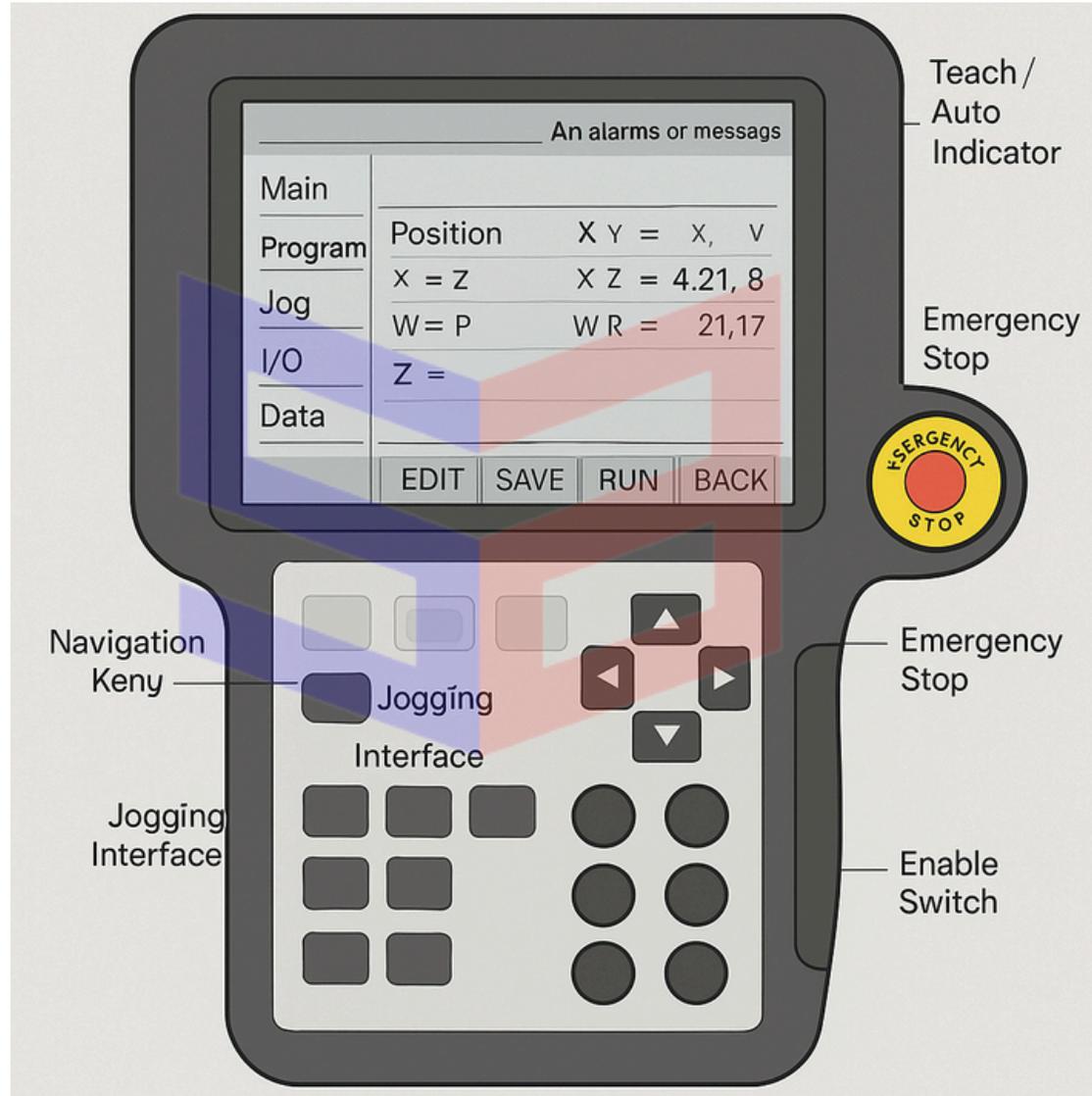- Status indicated on screen; robot disables all motion when triggered.

8. Teach/Auto Mode Indicator

- Clearly shows if robot is in **manual** or **automatic** mode.
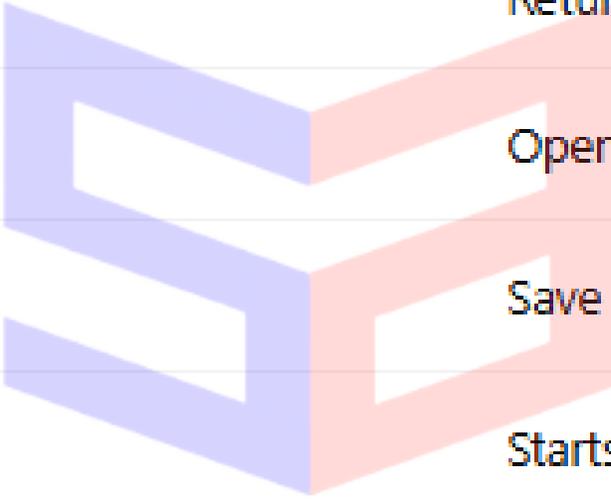
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USER INTERFACE

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TOUCH PENDANT FUNCTION KEYS

Function Key	Purpose
HOME	Returns to main menu or home screen.
EDIT	Opens the program for editing instructions.
SAVE / LOAD	Save current program or load existing ones.
RUN / START / PLAY	Starts executing the selected robot program.
STOP / HALT / PAUSE	Pauses or stops execution.

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TOUCH PENDANT FUNCTION KEYS

Function Key	Purpose
BACK	Returns to the previous screen or menu.
TOOL / UFRAME	Sets tool coordinate system or user frame.
JOG / MOVE	Activates manual jogging mode.
COORD / MODE	Toggles between coordinate systems (Joint, World, Tool, etc.)

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TOUCH PENDANT FUNCTION KEYS

Function Key	Purpose
I/O	Displays input/output status and configuration.
HELP / INFO	Provides context help or robot diagnostics.
ALARM / MESSAGES	Shows current alarms, warnings, or messages.

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TOUCH PENDANT FUNCTION KEYS

Types of Modes

Mode	Description
Teach Mode	Operator uses the pendant to manually move and program the robot.
Auto Mode	Robot runs programs automatically (often from PLC or external interface).
Manual Mode	Similar to Teach but with restricted motion (usually for testing).
Test Mode	Allows dry runs without actual motion, often used for debugging programs.
Playback Mode	Repeats previously taught motions in a loop (used for inspection or simple repeat jobs).

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TOUCH PENDANT FUNCTION KEYS

Types of Motion

Motion Type	Definition
Joint Motion (MoveJ)	Robot moves each joint independently to reach the target. Fast but less precise for path.
Linear Motion (MoveL)	Robot TCP moves in a straight line from one point to another. Critical for welding, sealing, etc.
Circular Motion (MoveC)	Moves the TCP in an arc or circular path between two points using a midpoint.
Spline Motion (MoveS)	Smooth multi-point motion for complex paths.
Joint Interpolation	Calculates trajectory based on joint angles.
Linear Interpolation	Calculates trajectory in Cartesian space (X, Y, Z).

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MCQs

What is the purpose of a teach pendant in a robotic cell?
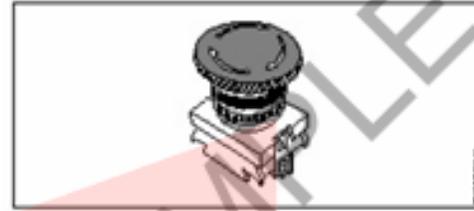
रोबोटिक सेल में टीच पेंडेंट का उद्देश्य क्या है?

A1 : To control the robot

रोबोट को कंट्रोल करना

A2 : To program the robot

रोबोट को प्रोग्राम करना

A3 : To power the robot

रोबोट को पावर प्रदान करना

A4 : To communicate with other machines in the cell

सेल में अन्य मशीनों के साथ कम्युनिकेट करना

Identify the button.

बटन को पहचानें?

A1 : Start button

स्टार्ट बटन

A2 : Hold button

होल्ड बटन

A3 : E-stop button

E-स्टॉप बटन

A4 : Shift button

शिफ्ट बटन

Full form of TCP is _____

TCP का फुल फॉर्म _____ है|

A1 : Tool File Setting

ट्रल फाइल सेटिंग

A2 : Tool Center Point

ट्रल सेंटर पॉइंट

A3 : Tool Center Pin

ट्रल सेंटर पिन

A4 : Tool Center Place

ट्रल सेंटर प्लेस

MCQs

Which keys are used to jog the robot?

रोबोट को जॉग करने के लिए किस कुंजी का उपयोग किया जाता है?

A1 : Page key

पेज की

A2 : Shift key

शिफ्ट की

A3 : Motion key

मोशन की

A4 : Jogging coordination key

जॉगिंग कोऑर्डिनेशन की

To change the coordination which key is used?

कोऑर्डिनेशन बदलने के लिए किस कुंजी का उपयोग किया जाता है?

A1 : INTERLOCK

INTERLOCK

A2 : COORD

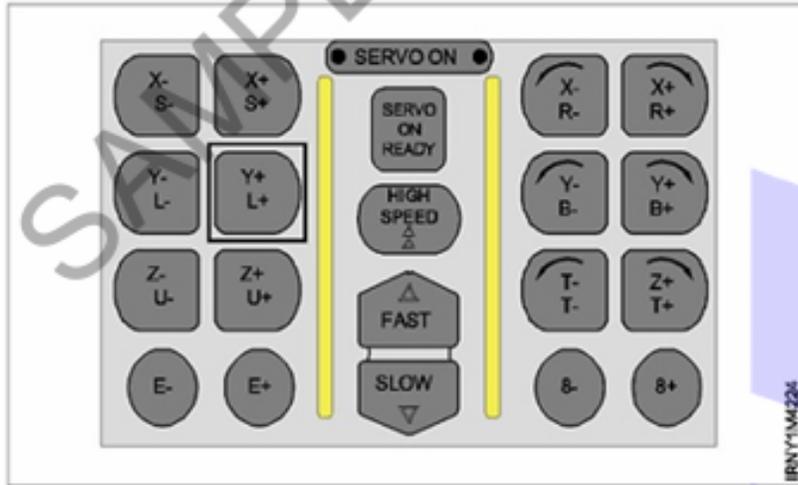COORD

A3 : FWD

FWD

A4 : BWD

BWD

MCQs

Name the teach pendent keys.

टीच पेंडेंट कुंजी का नाम बताइए।

A1 : Numerical function keys

न्यूमेरिकल फंक्शन की

A2 : Cursor keys

कर्सर की

A3 : Jogging coordinate Keys

जॉगिंग कोआर्डिनेट की

A4 : Display keys

How many areas are there in the teaching pendant display?

टीचिंग पेंडेंट डिस्प्ले में कितने एरिया होते हैं?

A1 : 2

2

A2 : 3

3

A3 : 4

4

A4 : 5

5

Thank you

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