

Section 1

Section 2 – Product Data & Specifications

Functional Description.

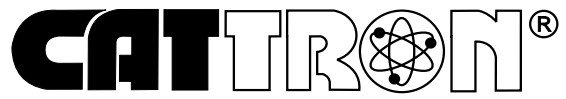
The CATTRON® Metal Keypad (MK) Series remote controller is a lightweight palm sized, extremely rugged customizable radio control unit for use with any CATTRON® Portable Radio Remote Control (PRRC) System. CATTRON® MK series controllers are offered in four family configurations: **EZ** (Easy), **CS** (Crane Specific), **AT** (Advanced Technology) and **UN** (Universal).

In all four CATTRON® families of MK series controllers, operational security is advanced to its maximum by the use of a removable stainless steel, electronic i-Key which, when installed to the controller, defines and enables the appropriate operating parameters. When the i-Key is removed, the controller is totally disabled.

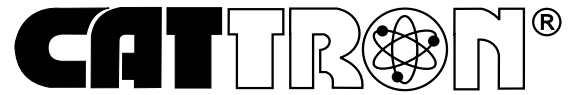
The keypad unit and electronics are contained in an extreme duty, water resistant and dust proof aluminum housing which has armorized rubber end-caps for switch protection and high impact resistance. Consequently, the MK series keypad controller is able to withstand levels of impact previously unattainable by any other portable remote controllers, without the need for carrying cases or protective rubber housings. The MK controller housing is ergonomically designed with curved bottom and rubber side grips to allow comfortable handling. The i-Key is mounted in a receptacle located within the confines of the armorized rubber ‘bumper’ that surrounds the top end-cap. Separate ON/OFF (green) and STOP (red) switches are also located next to the removable i-Key. A completely sealed elastomer keypad on the controller front face contains large pushbuttons that are coated with clear epoxy for additional durability. Each pushbutton is identified by a label that clearly indicates the specific function for that particular key. When pressed, each pushbutton actuates a function switch inside the controller and may be of single-step or two-step operation. Also, when pressed, each pushbutton has a distinct limit of travel, thus providing an enhanced tactile feel that is noticed by the operator.

All commands from CATTRON® MK controllers respond within milliseconds of pressing a pushbutton and are absolute functions; that is, a positive ON command is sent when the button is pressed, and a positive OFF command is sent when the same button is released. Additionally, a mainline ON command is sent when power is turned on and anytime a controller function pushbutton is pressed. Within the MK controller, a microprocessor performs self-diagnostics, interprets pushbutton and switch commands, and controls the radio transmitter.

CATTRON® MK controllers are available in single and dual-pressure models. Single-pressure models offer 4, 8, or 12 pushbutton functions (simultaneous, any combination), while dual-pressure models offer 6, 12, or 16 operator commanded functions (simultaneous, any combination). In addition, dual-pressure models provide 2-speed operation and variable frequency drive (VFD) operation with a single



pushbutton. All CATTRON® MK series controllers normally send on/off commands that activate programmed functions at the CATTRON® receiver/decoder.



Functional Description, continued.

CATTRON® MK controllers are equipped with an internal antenna and the typical operating (transmitter) range is in excess of 500 feet (160+ meters). It should be understood that operating range varies with environmental conditions. Should the transmitter go out of operating range, all motions will cease.

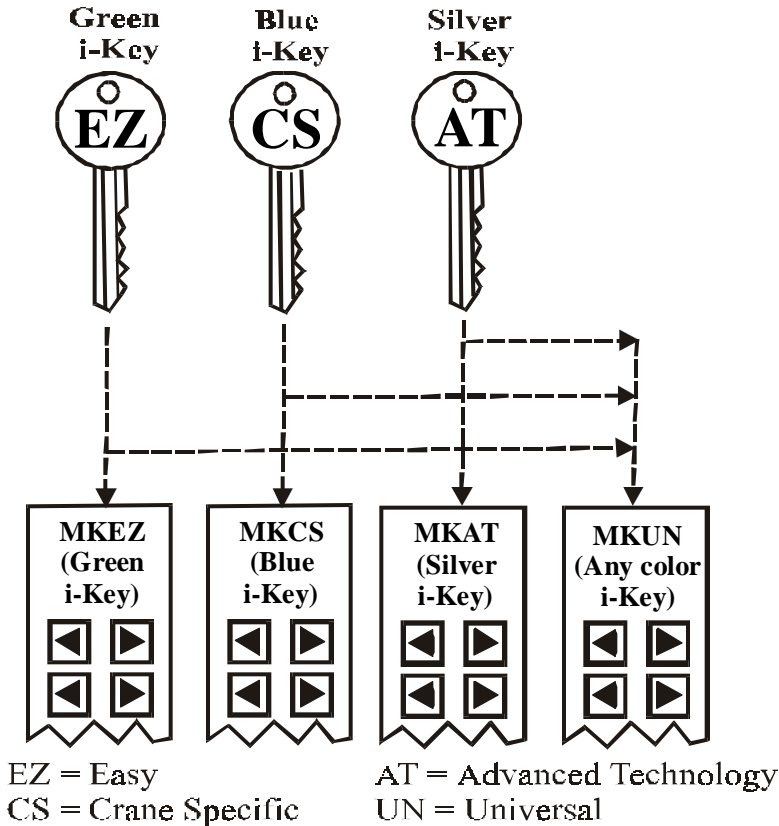
As previously mentioned, operational security is maximized by the need to use a stainless steel electronic i-Key for controller operation. However, there is an additional and very significant operational advantage of the CATTRON® i-Key concept. It is that individual system address, operating frequency and keypad configuration may be permanently stored in the i-Key, depending on the type of MK controller supplied. Therefore, CATTRON® MK series controllers belonging to the same family at a user location can be identical - only the i-Keys are different. To simplify, each i-Key is color coded and labeled for an individual control system family, thus, any CATTRON® MK controller will run any CATTRON® receiver/decoder belonging to the same family as long as the correct i-Key is used. As the result, this unique operating concept reduces the need for specific spare remote controllers. Our unique family of MK Series controllers is identified on the next page.

All CATTRON® MK series controllers are powered by disposable 3-Volt alkaline or re-chargeable Ni-Cad battery packs. In normal operation, a green LED 'flashes' with each function command message and a 'beep' is sounded when a key is pressed. When the battery voltage becomes low, a separate yellow LED flashes, alerting the operator that the battery pack needs to be replaced or re-charged soon. Battery packs are easily and quickly replaced without the need for tools by turning two knurled thumbscrews and removing the battery cover-plate located within the confines of the armored rubber bottom end-cap. The battery pack makes positive contact without snaps or plugs and has no wires to break; simply drop it in, and replace the battery cover-plate.

Ni-Cad battery packs can be re-charged 'in-situ' and do not need to be removed from the controller housing. To enable such battery charging to be carried out, an optional 'standard rate' (10-hour) battery charger is available for all CATTRON® MK series controllers. One end of this charger is connected to a standard 120VAC outlet, the other plugs into a covered socket located on the curved underside of the controller. A 'rapid rate' (1-hour) battery charger is available on request.

A belt loop strap is available for all CATTRON® MK series controllers. This is quickly and simply installed to a 'D'-ring located on the curved underside of the controller. Also, an optional shoulder carrying strap is available on request.

Our MK Family of Remote Controllers



NOTE: EACH FAMILY OF MK CONTROLLER IS IDENTIFIED BY THE APPROPRIATE COLORED SPOT LOCATED NEXT TO THE i-KEY RECEPTACLE.

Specifications.

Case Material:

Extreme duty, water resistant and dust proof aluminum housing.

Approximate weight:

1.4lbs. / 634 grams (including battery pack).

Dimensions:

8.0" x 3.0" x 2.0" (20.0cm x 7.6cm x 5.1cm).

Environmental:

Consult CATTRON® factory for a wide range of environmental solutions.

Specifications, continued.

Maximum Functions:

Single-pressure MK models:

4, 8, 12 (simultaneous, any combination) operator commands.

Dual-pressure MK models:

6, 12, 16 (simultaneous, any combination) operator commands.

Auxiliary functions can be added for either model:

i.e., trolley/hoist select, crane select (with i-Key only), etc.

Switch options:

4, 8, or 12 pushbuttons, single or dual pressure.

Switch type:

Sealed silicon elastomer keypad, dust, water, oil, acid resistant elastomer pad with 'tactile feel', clear epoxy coated pushbuttons.

Battery life (continuous operation):

3 Volt alkaline battery pack (standard) or re-chargeable Ni-Cad battery pack (optional). In USA, Canada and non EU countries, battery life is:- Ni-Cad pack – 65 hours, Alkaline pack – 150 hours. In EU countries, battery life is:- Ni-Cad pack – 40 hours, Alkaline pack – 95 hours.

Transmit indicator:

Green LED flashes with every transmission.

Low battery indication:

Yellow LED flashes for low battery, low battery alert signal beeps every 10 seconds.

Battery charging:

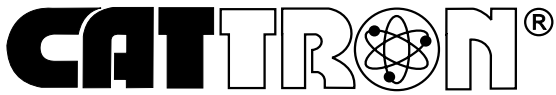
Internal Ni-Cad battery charging. Optional 'standard rate' (10 hour) or 'rapid rate' (1-hour) battery chargers available.

Audio speaker:

For function pushbutton 'click' and low battery indication.

Transmitter frequency:

425-447MHz (M) **or** 447-473MHz (H).



Overview – Cattron® Radio Remote Control Systems.

Figure 1-1 below shows a simplified block diagram of a typical CATTRON® radio remote control system. Refer to this figure and the following paragraphs for a functional description of the remote control system.

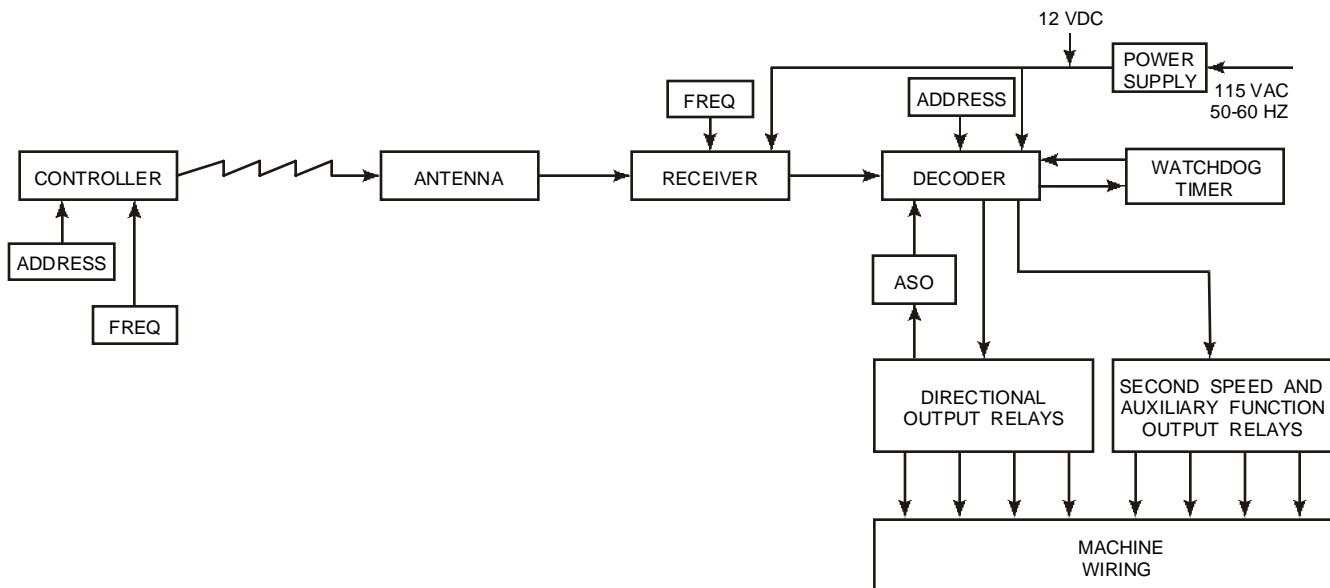
The target receiver/decoder is controlled by the **MK controller**. Provided the correct **coded i-Key** is inserted into the keypad controller, the controller sends signals to the receiver/decoder using a UHF radio link. The signal is picked up by the antenna and passed on to the receiver. If the signal is the correct frequency and passes all required data tests, the signal is passed on to the decoder.

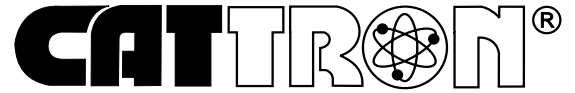
The decoder compares the address code of the signal to its own address code. If the signal's address code does not match its address code, it is ignored and a message is displayed on a system status display located in the receiver/decoder unit. If the address code is correct, the decoder processes the message and energizes and de-energizes the appropriate control, directional output, second speed and auxiliary function relays located within the control system.

An Automatic Safety Override (ASO) function continually monitors the state of any safety directional relay output (i.e. Forward/Reverse). If a monitored relay electrically fails closed without a command from the controller, the ASO circuit logic de-energizes the master output relay (OPR).

During operation, the microprocessor on the decoder board resets multiple watchdog timer circuits whenever valid messages are received and decoded. If the microprocessor fails to reset the watchdog timers, the timer circuits shut down and de-activate all relay outputs. The decoder microprocessor requires continuously valid transmitted signals to be received and decoded or all relay output functions will be de-activated unless programmed otherwise.

Figure 1-1. Typical Radio Remote Control System, simplified block diagram





MK AT Series Keypad Controllers – Availability Options.

The various configurations available for the CATTRON® Advanced Technology (AT) family of MK Series Controllers are summarized below:

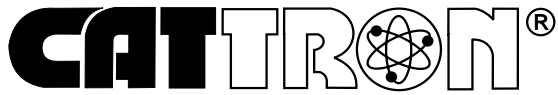
NOTE: This MK Controller is custom built for your remote control application. When ordering any replacement part, provide the following information: (1) the model and revision number located on the serial tag underneath the controller, and (2) the control system ID and serial number located on the i-Key label tag.

MK (AT Family) Remote Controllers - model summary chart.

MODEL PART NUMBER (Suffix Codes: **DP** = Dual Pressure. **DS** = Display. **+2** = additional function keys. **S** = Switch)

KM16DP	KM12DP	KM06DP	KM04	KM08	KM12	KM12+2	KM12DS	KM12S	LEGEND
									- = NOT AVAILABLE
									1 = NUMBER SUPPLIED
									+ = ACCESSORY
1	1	1	1	1	1	1	1	1	Frequency Band Range From 425-447MHz (M) <u>or</u> 447-473MHz (H)
-	-	1	1	-	-	-	-	-	4 Function Buttons
-	1	-	-	1	-	-	-	-	8 Function Buttons
1	-	-	-	-	1	1	1	1	12 Function Buttons
1	1	1	1	1	1	1	1	1	Power On/Off Switch (green)
1	1	1	1	1	1	1	1	1	Internal Antenna
1	1	1	1	1	1	1	1	1	System Stop (red)
-	-	-	-	-	-	-	1	-	Liquid Crystal Display
1	1	1	1	1	1	1	1	1	Belt Loop Carrying Strap, 2" Black Nylon, Part Number 42C-0066
+	+	+	+	+	+	+	+	+	Shoulder Carrying Strap, Part Number 42C-0057
1	1	1	1	1	1	1	1	1	Alkaline Battery Pack, Part Number 60C-0060A
+	+	+	+	+	+	+	+	+	Ni-Cad Rechargeable Battery Pack, Part Number 60C-0060N
+	+	+	+	+	+	+	+	+	Ni-Cad Standard Rate (10-hr) Battery Charger, Part Number 70C-0001
+	+	+	+	+	+	+	+	+	Ni-Cad Rapid Rate (1-hr) Battery Charger, Part Number 70C-0002

END OF SECTION



Section 2 – Safety Information

Safety Considerations.

CATTRON® believes that to safely operate any remotely controlled equipment, the overall system needs to be configured so that movement or operation of the equipment will take place only when the device is commanded to move or operate. For example; overhead cranes must be equipped with a braking system which can only be released when an electrical signal is sent to the motor. Removal of electrical power or loss of the radio transmitted signal results in application of the brakes. This is accomplished when a CATTRON® Electro-Hydraulic brake package is installed – contact the factory for details.

In keeping with this philosophy - **NO COMMAND, NO MOVEMENT** - CATTRON® has designed your radio remote control system with the following safety and security features.

Standard Safety & Security Features.

i-Key: Operational security is advanced to its maximum by the use of a removable stainless steel, electronic, i-Key which, when installed to the MK controller, defines and enables the operating parameters. When the i-Key is removed, the controller is totally disabled.

Unique address code: Each MK controller and receiver/decoder pair is configured with a unique address code so that the equipment will respond only to the controller whose address code matches that of the decoder.

Intelligent digital message protocol: CATTRON® remote control systems utilize a unique message protocol for industrial control applications rather than the customary Electronic Data Processing (EDP) type of message format.

Green ON/OFF power switch: The MK controller is provided with a green power ON/OFF switch that must be set to 'ON' in order to send commands to the receiver/decoder. If the power switch is set to 'OFF', the decoder will remove all commands from the controlled machinery, stopping all movement.

Red System STOP Switch: Operating the red STOP switch while the MK controller is turned on will repeatedly send a burst of stop commands to all outputs including the mainline control relay (OPR).

Operate relay (OPR): The operate (OPR) output relay shall be wired to control a user-provided electro-magnetic power contactor. The electro-magnetic contactor opens and closes the main electrical supply circuit(s) to the controlled device.

Automatic Safety Override: The Automatic Safety Override (ASO) function continually monitors all selected decoder directional relays and safety related outputs. If any monitored relay closes without command from the MK controller, the Operate (OPR) Relay immediately de-energizes. This prevents any movement of the controlled machine without command from the controller.

Standard Safety & Security Features, continued.

Data Error Checking: All communications from the MK controller to the receiver/decoder contain error-checking information (BCH data error detection routines). The entire data command packet must pass error detection tests before being processed.

Typical method of operation (incorporating above safety features).

Using a radio controlled overhead crane as an example:

WARNINGS:

- 1. ALL EQUIPMENT MUST HAVE A MAINLINE (ML) CONTACTOR INSTALLED AND ALL TRACKED EQUIPMENT (i.e. CRANES) HAVE A BRAKE INSTALLED.**
- 2. THE REMOTE CONTROL OPERATE (OPR) RELAY MUST BE CONNECTED TO THE MAINLINE SO THAT STOP COMMANDS OR FAULT CONDITIONS MONITORED BY AUTOMATIC SAFETY OVERRIDE (ASO) CIRCUITRY WILL DE-ENERGIZE THE MAINLINE CONTACTOR AND SET THE EQUIPMENT BRAKE.**
- 3. ALL EQUIPMENT SHALL HAVE AUDIO AND VISUAL ALARM INDICATIONS MEETING GOVERNMENTAL REQUIREMENTS.**
- 4. MORE THAN ONE REMOTE CONTROL SYSTEM MAY BE USED AT, AROUND, OR NEARBY YOUR OPERATING FACILITY. THEREFORE, BEFORE INSERTING AN 'i-KEY' INTO AN MK CONTROLLER, YOU MUST INSURE THE CORRECT CODED 'i-KEY' IS SELECTED FOR THE DESIRED EQUIPMENT TO BE OPERATED.**
- 5. IF THE WRONG 'i-KEY' IS INSERTED INTO AN MK CONTROLLER, OTHER EQUIPMENT LOCATED AT, AROUND, OR NEARBY YOUR FACILITY MAY BECOME OPERATIONAL.**

FAILURE TO COMPLY WITH THE ABOVE WARNINGS MAY RESULT IN OPERATION OF UNDESIRED EQUIPMENT WHICH IN TURN COULD RESULT IN PERSONAL INJURY OR DEATH TO PERSONNEL AND DAMAGE TO EQUIPMENT

The Operate (OPR) relay(s) is energized for the first time when:

The red STOP and green ON/OFF switches on the MK Controller are pulled out in the proper sequence (red, then green), the correct coded i-Key is installed, and the target receiver/decoder has power applied. With all these conditions satisfied, a matching address code is sent by way of RF signal from the MK controller to the decoder.

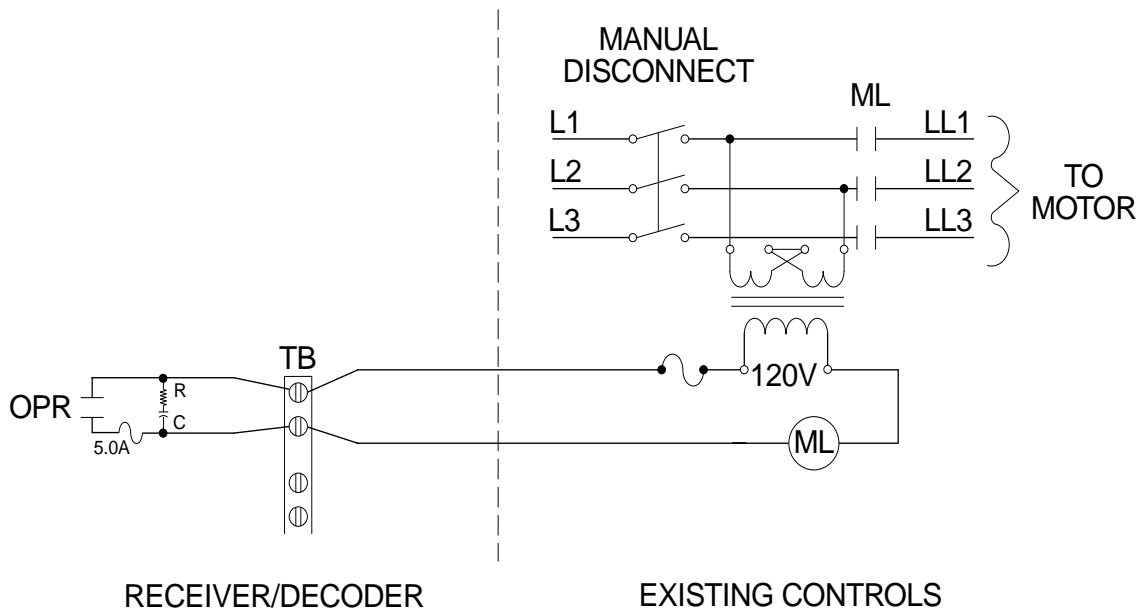
Typical method of operation, continued.

The OPR relay is wired to the mainline (ML) contactor on the crane. Once the mainline is energized, a continuously repeated valid signal must be received for function outputs to engage. If this signal is interrupted for any reason, all function outputs will turn off unless programmed otherwise.

Figure 2-1 below shows an Operate (OPR) contact wired directly to the mainline (ML) contactor. Provided the red STOP switch on the MK Controller is pulled out and the correct coded i-Key is installed, setting the green ON/OFF power switch on the MK controller to 'ON' will energize the mainline contactor.

An auxiliary function may be used as a Reset (RST) output that will only be effective when the Operate (OPR) relay has been closed. Momentary closure of the Reset (RST) relay picks up the mainline (ML) contactor, which is maintained under control of the OPR. Thus, power is supplied to the controlled device. If OPR opens, the mainline contactor releases, removing power from the controlled device and stopping all motion.

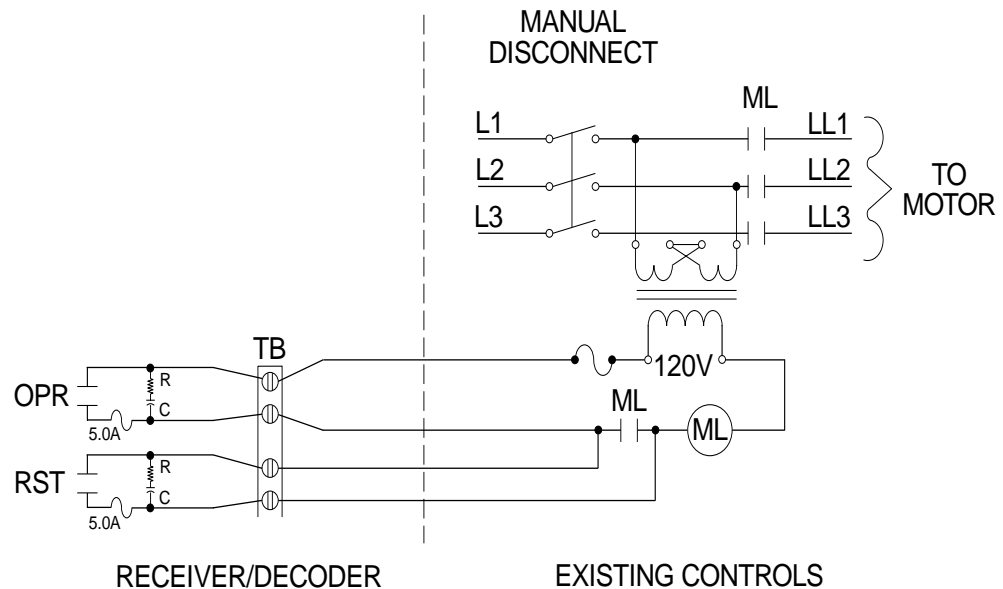
Figure 2-1. Operate (OPR) contact wiring



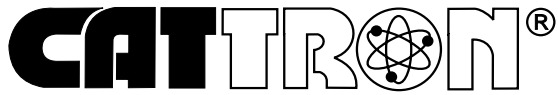
Typical method of operation, continued.

Figure 2-2 below shows the Operate (OPR) relay and optional Reset (RST) relay wired to control a mainline contactor. This configuration requires the operator to activate the reset function on the controller after he/she has turned the unit on. Once reset, the ML contactor stays energized until OPR de-energizes.

Figure 2-2. Operate (OPR) contactor and Reset Relay (RST) wiring



In addition to being energized by the presence of a signal from the controller, OPR is under supervision of the Automatic Safety Override (ASO) circuit. The ASO circuit disables the OPR (shutting down the controlled machinery) if an ASO circuit monitored output relay is active when no corresponding command is being received from the controller. In this event, no action is required by the operator to stop the equipment. The ASO safety circuitry will stop motion automatically without any operator command when a monitored output relay fault is detected.



Radio Control Operator's Duties – General Equipment.

The following procedures provide general guidelines for radio control operation of equipment and should not be used as a substitute for your plant operating procedures.

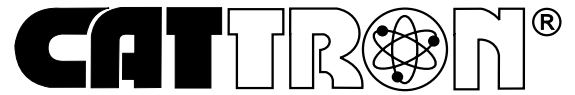
1. Before operating equipment, carry out the following:

WARNINGS:

1. ALL EQUIPMENT MUST HAVE A MAINLINE (ML) CONTACTOR INSTALLED AND ALL TRACKED EQUIPMENT (i.e. CRANES) HAVE A BRAKE INSTALLED.
2. THE REMOTE CONTROL OPERATE (OPR) RELAY MUST BE CONNECTED TO THE MAINLINE SO THAT STOP COMMANDS OR FAULT CONDITIONS MONITORED BY AUTOMATIC SAFETY OVERRIDE (ASO) CIRCUITRY WILL DE-ENERGIZE THE MAINLINE CONTACTOR AND SET THE EQUIPMENT BRAKE.
3. ALL EQUIPMENT SHALL HAVE AUDIO AND VISUAL ALARM INDICATIONS MEETING GOVERNMENTAL REQUIREMENTS.
4. MORE THAN ONE REMOTE CONTROL SYSTEM MAY BE USED AT, AROUND, OR NEARBY YOUR OPERATING FACILITY. THEREFORE, BEFORE INSERTING AN 'i-KEY' INTO AN MK CONTROLLER, YOU MUST INSURE THE CORRECT CODED 'i-KEY' IS SELECTED FOR THE DESIRED EQUIPMENT TO BE OPERATED.
5. IF THE WRONG 'i-KEY' IS INSERTED INTO AN MK CONTROLLER, OTHER EQUIPMENT LOCATED AT, AROUND, OR NEARBY YOUR FACILITY MAY BECOME OPERATIONAL.

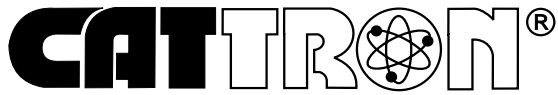
FAILURE TO COMPLY WITH THE ABOVE WARNINGS MAY RESULT IN OPERATION OF UNDESIRED EQUIPMENT WHICH IN TURN COULD RESULT IN PERSONAL INJURY OR DEATH TO PERSONNEL AND DAMAGE TO EQUIPMENT

- a. Install the correct coded **i-Key** for the desired equipment to be operated. If the wrong coded i-Key is installed to the MK controller, the target equipment will not operate. However; other equipment located at, around, or nearby your facility may become operational.



Radio Control Operator's Duties – General Equipment, continued.

- b. Set (pull out) MK controller red STOP switch to 'RUN' and set (pull out) green ON/OFF power switch to 'ON'. When transmitting with a good battery, two short 'beeps' will be heard immediately after the ON/OFF power switch is set to 'ON' and the green TRANSMIT LED will 'flash' rhythmically. When the battery starts to go low, the yellow LOW BATTERY LED will 'flash' continuously, which means you should change or re-charge the battery pack (refer to **Battery Pack** in Section 4 of this manual for instructions on how to replace a battery pack).
 - c. When installed, depress ALARM/RESET pushbutton on MK controller (this is normally an optional function that sounds the equipment alarm and resets the main power contactor).
 - d. Check each function independently to be sure that equipment is responding correctly.
 - e. Where a limit switch is provided, you should check the limit switch at the beginning of each shift as defined by your plant operating procedures.
 - f. Check range limiting if used.
 - g. Check STOP operation
 - h. Check brake operation.
2. You must report all defective or missing safety equipment, mechanical or electrical defects to your supervisor without delay. Do not continue operation until fully repaired.
 3. If anyone is in the path of equipment travel, stop and sound the alarm before proceeding.
 4. Persons operating this equipment shall not use a limit stop as a utility stopping device.
 5. When leaving the equipment area for any reason, set (push down) the MK controller red STOP switch to 'STOP' and set (push down) the green ON/OFF power switch to 'OFF'. Remove the i-Key from the MK controller and keep it on your person.
 6. Do not allow any unauthorized person to operate the MK controller.
 7. Do not operate the MK controller at a distance where the equipment and all surrounding objects are not visible.
 8. Do not attempt to override any of the safety features built into the Radio Control System.
 9. If for any reason you or anyone has to board the radio controlled equipment, set (push down) the MK controller red STOP switch to 'STOP' and set (push down) the green ON/OFF power switch to 'OFF'. Remove the i-Key from the MK controller and keep it on your person.



Radio Control Operator's Duties – E.O.T. Crane.

The following procedures provide general guidelines for radio control operation of a crane and should not be used as a substitute for your plant operating procedures.

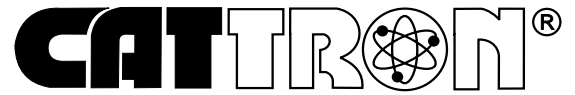
1. Before lifting any loads, carry out the following:

WARNINGS:

1. ALL EQUIPMENT MUST HAVE A MAINLINE (ML) CONTACTOR INSTALLED AND ALL TRACKED EQUIPMENT (i.e. CRANES) HAVE A BRAKE INSTALLED.
2. THE REMOTE CONTROL OPERATE (OPR) RELAY MUST BE CONNECTED TO THE MAINLINE SO THAT STOP COMMANDS OR FAULT CONDITIONS MONITORED BY AUTOMATIC SAFETY OVERRIDE (ASO) CIRCUITRY WILL DE-ENERGIZE THE MAINLINE CONTACTOR AND SET THE EQUIPMENT BRAKE.
3. ALL EQUIPMENT SHALL HAVE AUDIO AND VISUAL ALARM INDICATIONS MEETING GOVERNMENTAL REQUIREMENTS.
4. MORE THAN ONE REMOTE CONTROL SYSTEM MAY BE USED AT, AROUND, OR NEARBY YOUR OPERATING FACILITY. THEREFORE, BEFORE INSERTING AN 'i-KEY' INTO AN MK CONTROLLER, YOU MUST INSURE THE CORRECT CODED 'i-KEY' IS SELECTED FOR THE DESIRED EQUIPMENT TO BE OPERATED.
5. IF THE WRONG 'i-KEY' IS INSERTED INTO AN MK CONTROLLER, OTHER EQUIPMENT LOCATED AT, AROUND, OR NEARBY YOUR FACILITY MAY BECOME OPERATIONAL.

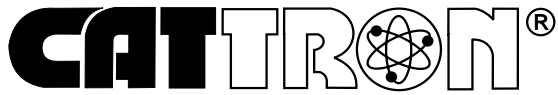
FAILURE TO COMPLY WITH THE ABOVE WARNINGS MAY RESULT IN OPERATION OF UNDESIRED EQUIPMENT WHICH IN TURN COULD RESULT IN PERSONAL INJURY OR DEATH TO PERSONNEL AND DAMAGE TO EQUIPMENT

- a. Install the correct coded **i-Key** for the desired equipment to be operated. If the wrong coded i-Key is installed to the MK controller, the target equipment will not operate. However; other equipment located at, around, or nearby your facility may become operational.



Radio Control Operator's Duties – E.O.T. Crane, continued.

- b. Set (pull out) MK controller red STOP switch to 'RUN' and set (pull out) green ON/OFF power switch to 'ON'. When transmitting with a good battery, two short 'beeps' will be heard immediately after the ON/OFF power switch is set to 'ON' and the green TRANSMIT LED will 'flash' rhythmically. When the battery starts to go low, the yellow LOW BATTERY LED will 'flash' continuously, which means you should change or re-charge the battery pack (refer to **Battery Pack** in Section 4 of this manual for instructions on how to replace a battery pack).
 - c. When installed, depress ALARM/RESET pushbutton on MK controller (this is normally an optional function that sounds the alarm and resets the main power contactor).
 - d. Check each function independently to be sure that equipment is responding correctly.
 - e. Where a limit switch is provided, you should check the limit switch at the beginning of each shift as defined by your plant operating procedures.
 - f. Check range limiting if used.
 - g. Check STOP operation.
 - h. Check Brake operation
2. You must report all defective or missing safety equipment, mechanical or electrical defects to your supervisor without delay. Do not continue operation until fully repaired.
 3. When raising or lowering a load, proceed slowly and make certain the load is under control.
 4. When lifting maximum load, you should test the brakes by raising the load a few inches from the floor. If the brakes will not hold, the load shall be immediately lowered and not moved until brakes are adjusted or repaired.
 5. Center the Trolley directly over the load before starting to hoist.
 6. Take slack out of chains or slings gradually and make sure hands and other objects are clear before making the lift.
 7. Keep all parts of the body away from the lifts. Also, do not stand under a lift.
 8. Do not make a lift or move the equipment if anyone is in a position to be injured.
 9. Load should not be carried over workmen's heads.
 10. If anyone is in the path of travel, stop and sound the alarm before proceeding.



Radio Control Operator's Duties – E.O.T. Crane, continued.

11. Do not drag slings, chains, etc. along the floor.
12. Persons operating this equipment shall not use a limit stop as a utility stopping device.
13. Bumping other cranes or run-away stops is prohibited.
14. When moving the equipment to the loading point, be sure that hook block, attachment, or cables will not fall on the adjacent equipment.
15. When leaving the crane area for any reason, be sure slings or chains are raised and set (push down) the MK controller red STOP switch to 'STOP'. Set (push down) the green ON/OFF power switch to 'OFF'. Remove the i-Key from the MK controller and keep it on your person.
16. Do not allow any unauthorized person to operate the MK controller.
17. Do not operate the MK controller at a distance where the crane and all surrounding objects are not visible.
18. Do not attempt to override any of the safety features built into the Radio Control System.
19. If for any reason you or anyone has to board a radio controlled crane, set (push down) the MK controller red STOP switch to 'STOP' and set (push down) the green ON/OFF power switch to 'OFF'. Remove the i-Key from the MK controller and keep it on your person.

END OF SECTION

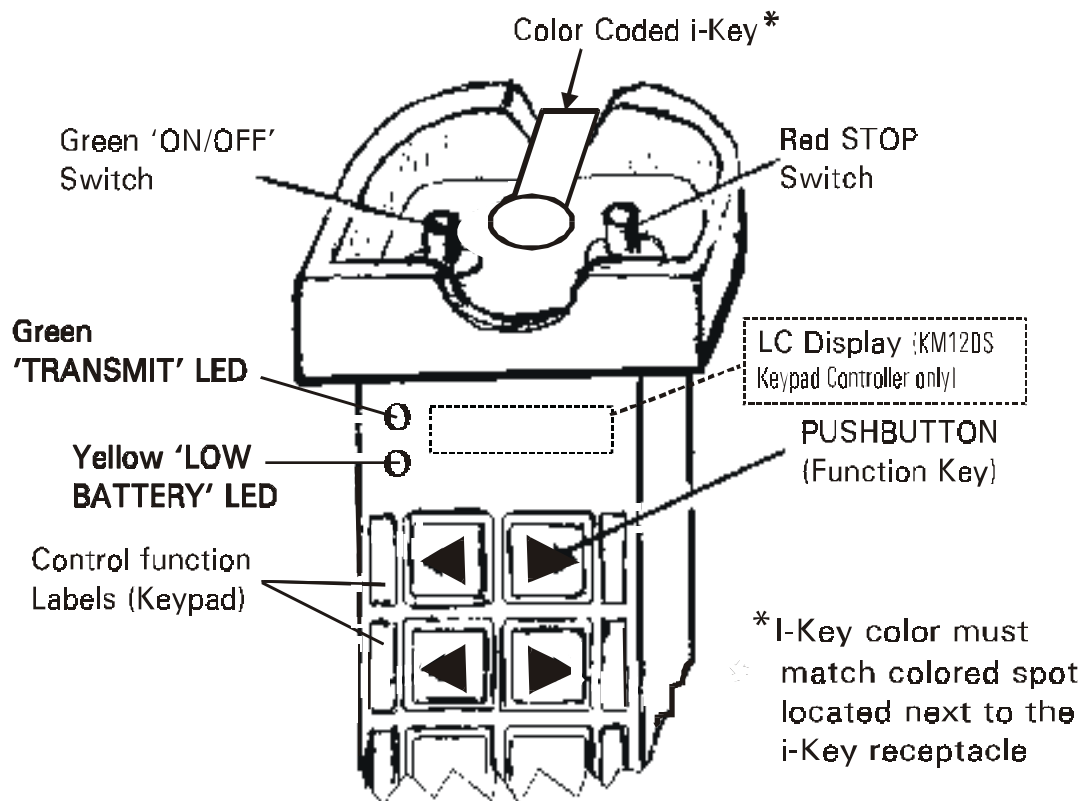
Section 3 – Operating Instructions

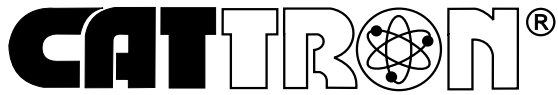
Controls and Indicators.

The standard MK Series Controller is a lightweight hand-held unit with up to twelve pushbuttons (function keys) on a single keypad, plus a pull/push ON/OFF switch and a push/pull STOP switch. The color coded i-Key sets the operating parameters for your control system and has been pre-configured at our factory. Your MK series controller has been custom engineered to duplicate all the control functions normally found on the equipment being controlled and may contain basic control functions as well as some auxiliary functions, depending on system application. The controller may be hand carried, held by a belt loop strap or an optional shoulder carrying strap. The keypad controller is powered by a disposable (Alkaline), or rechargeable (Ni-Cad), battery pack.

Referring to Figure 3-1 below, all MK Series Controllers have the following Controls and Indicators:

Figure 3-1. Operator controls and indicators





Controls and Indicators, continued.

Referring to Figure 3-1, above, with the correct color coded **'i-Key'** inserted into the MK controller, pulling both the STOP and ON/OFF switches to their respective 'RUN' and 'ON' positions will apply power to the transmitter. When transmitting with a good battery, two short 'beeps' will be heard immediately after the ON/OFF power switch is set to 'ON' and the green TRANSMIT LED will 'flash' rhythmically. In addition, any time a pushbutton (function key) is pressed, the green TRANSMIT LED will 'flash' during each radio transmission.

When the battery energy starts to go low, the yellow LOW BATTERY LED will 'flash' continuously, signaling the operator to change or re-charge the battery pack (refer to **Battery Pack** in Section 4 of this manual for instructions on how to replace a battery pack). When the ON/OFF switch is set (pushed) to the 'OFF' position, all control functions will cease.

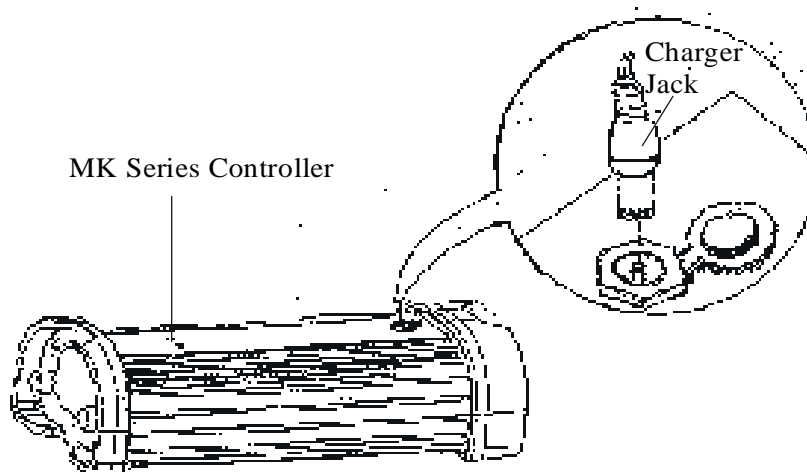
All active Function Key (pushbutton) commands are identified using labels placed next to each pushbutton. When a pushbutton is depressed, the controller transmits the corresponding command (as labeled). All pushbutton operations are momentary and must be maintained by the operator. Releasing the pushbutton will send an 'OFF' command that de-energizes the corresponding output function. The controller stops sending commands five seconds after the last pushbutton is released. A 'beep' will be heard each time a button is pressed or released.

Setting (pushing down) the red STOP switch to 'STOP' immediately sends a burst of stop commands to the receiver/decoder unit. Immediately after the stop commands have been sent, the transmitter within the keypad controller switches OFF. STOP commands will automatically be repeated for one minute or until the green ON/OFF switch is set (pushed) to the 'OFF' position.

Battery Charging (optional).

When installed, the re-chargeable Ni-Cad battery pack can be re-charged 'in-situ' and does not need to be removed from the Keypad Controller housing. **In this unit, it is not recommended to re-charge the battery until the yellow LED flashes continuously.**

Figure 3-2. Battery Charging



Battery Charging, continued.

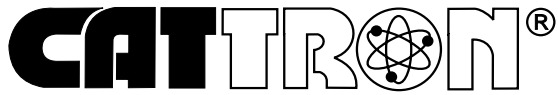
To re-charge the Battery, refer to Figure 3-2 above, and connect the transformer end of the battery charger to a standard 120VAC outlet. Position the Keypad Controller face down, open out the hinged cover protecting the charging socket and insert the charger jack. Using the standard rate battery charger, a fully discharged Ni-Cad battery pack will take approximately 10 hours to fully charge. Using the rapid rate battery charger, a fully discharged Ni-Cad battery pack will take approximately 1 hour to fully charge.

Operating Procedure – single pressure keypad controller.

Note that all single pressure function keys are clearly marked with single arrows on the face of the pushbutton.

WARNINGS:

- 6. ALL EQUIPMENT MUST HAVE A MAINLINE (ML) CONTACTOR INSTALLED AND ALL TRACKED EQUIPMENT (i.e. CRANES) HAVE A BRAKE INSTALLED.**
 - 7. THE REMOTE CONTROL OPERATE (OPR) RELAY MUST BE CONNECTED TO THE MAINLINE SO THAT STOP COMMANDS OR FAULT CONDITIONS MONITORED BY AUTOMATIC SAFETY OVERRIDE (ASO) CIRCUITRY WILL DE-ENERGIZE THE MAINLINE CONTACTOR AND SET THE EQUIPMENT BRAKE.**
 - 8. ALL EQUIPMENT SHALL HAVE AUDIO AND VISUAL ALARM INDICATIONS MEETING GOVERNMENTAL REQUIREMENTS.**
 - 9. MORE THAN ONE REMOTE CONTROL SYSTEM MAY BE USED AT, AROUND, OR NEARBY YOUR OPERATING FACILITY. THEREFORE, BEFORE INSERTING AN ‘i-KEY’ INTO AN MK CONTROLLER, YOU MUST INSURE THE CORRECT CODED ‘i-KEY’ IS SELECTED FOR THE DESIRED EQUIPMENT TO BE OPERATED.**
 - 5. IF THE WRONG ‘i-KEY’ IS INSERTED INTO AN MK CONTROLLER, OTHER EQUIPMENT LOCATED AT, AROUND, OR NEARBY YOUR FACILITY MAY BECOME OPERATIONAL.**
- FAILURE TO COMPLY WITH THE ABOVE WARNINGS MAY RESULT IN OPERATION OF UNDESIRED EQUIPMENT WHICH IN TURN COULD RESULT IN PERSONAL INJURY OR DEATH TO PERSONNEL AND DAMAGE TO EQUIPMENT**



Operating Procedure – single pressure keypad controller, continued.

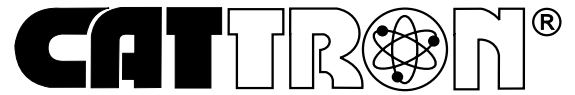
CAUTION:

If the MK Controller is used or left standing in an upright position during very wet weather, or in hostile environments where large amounts of moisture are present, water will seep into the 'i-key' receptacle and stop all control functions. To resume control functions, simply invert and shake the controller to remove excess water from the 'i-key' receptacle. Ideally, to prevent such occurrences, the controller should: (1) never be left standing upright, (2) always be carried by the appropriate belt loop or shoulder strap, and (3) operated in a near horizontal position during wet weather.

1. **Insert correct color coded 'i-Key'.** This coded electronic key sets the unique operating parameters for a given control system. These parameters include, address code, operating frequency and function key (pushbutton) configurations. The i-key is simply installed by pressing into its receptacle. Once installed, the i-key may be further secured to the controller using the metal stud located behind the rubber bumper. Note the controller will not operate without an i-Key installed. However; other equipment located at, around, or nearby your facility may become operational.
2. **Set red STOP Switch to 'RUN'.** Pulling this switch upwards enables power to be applied to the controller.
3. **Set green ON/OFF Switch to 'ON'.** Pulling this switch upwards applies power to the controller. Two quick 'beeps' with the green TRANSMIT LED flashing rhythmically indicates the controller is ready for use and a power up message has been sent to the target receiver/decoder. The targeted receiver/decoder will respond by energizing the mainline contactor of your controlled equipment.
4. **Press any active Function Key (pushbutton).** The MK controller is now fully operational and transmitting a signal as indicated by the green TRANSMIT LED flashing. Operate the keypad control and auxiliary pushbuttons as required, remembering that each pushbutton must be maintained in order for the function to continue to operate. Any or all functions may be operated simultaneously if the controlled machine permits such operation.

NOTES: A system STOP may be initiated at any time during the control function by pushing the red STOP switch downwards. It should be further noted that in "pitch and catch" control operations where two MK controllers are used, only the controller (i-Key) that sets the 'STOP' condition will re-set the 'RUN' condition.

When all control functions have been completed, we recommend you initiate a system STOP (push red STOP switch down) before setting (pushing) the green ON/OFF switch to the 'OFF' position.



Operating Procedure – dual pressure keypad controller.

Note that all dual pressure function keys are clearly marked with double arrows on the face of the pushbutton.

Your Dual Pressure (DP) function key pushbuttons have been pre-assigned through i-Key programming for two-step operation. In other words, **a second output is tied to the second level of button depression**. Other than the outputs of dual pressure pushbuttons, functional operation of the keypad controller is the same as the single pressure controller described above.

Operating principle (dual pressure keypad controllers).

Typically, Dual Pressure (DP) controllers send one of two output commands to the receiver/decoder from a single button. DP buttons are paired to opposite directions of the same output, (i.e., forward and reverse). These two buttons will control direction and speed relays. The first level of depression on each button will command the desired direction and first step of movement (two directions = two relays). The third relay is operated by either button's second level of depression to the second speed output of the controlled equipment. This could be a single relay, or two separate relays assigned for the second speed step or for the VFD accelerate output (for the button in use).

If the DP button is depressed to its first level, first speed is achieved and maintained as long as the button remains at that level of depression. If the button is depressed to its second level, second speed is achieved. If the operator releases pressure and allows the button to return to the first level, first speed is again achieved.

Moving directly from 'OFF' to the second level of depression *can* command second speed if sufficient pressure is applied. For example, one of two DP buttons labeled 'FORWARD' and 'REVERSE' is used at the first pressure level to command the direction and first speed of the equipment. The second pressure level of the button in use will command a second speed.

END OF SECTION