

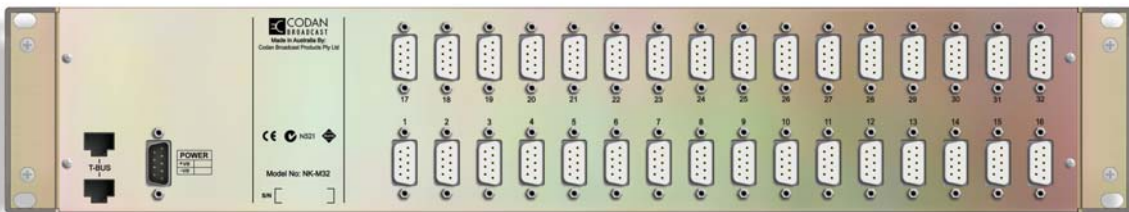
## Machine Control Routing with the NK Series

### Introduction

The NK-M16 and NK-M32 machine control routers enable routing of RS422 signals between two or more devices, with auto reciprocal switching. This application note provides examples of how the NK Series machine control routers are configured and operated using Phoenix Control Surface software.



NK-M16



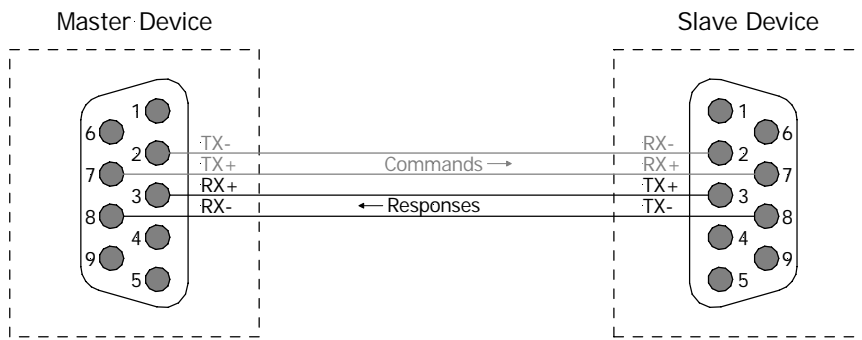
NK-M32

### RS422 Machine Control

RS422 is a standard which defines the electrical interface used for serial data communications between devices over twisted pair.

Broadcast equipment such as VTR's, remote controllers and edit workstations are typically equipped with an RS422 connection or *port* in the form of a DB9 connector, which allows a bi-directional connection with similar equipment for the purpose of controlling the transportation of video and audio signals in a facility.

RS422 machine control communication between two devices consists of commands from a master device to a slave device carried on one pair of wires, followed by responses from the slave device back to the master device carried on a second pair of wires. This means that the signal on a pair of connector pins changes direction or *sense* depending on whether the device is acting as a master or slave.



**RS422 Machine Control Bi-directional Connection Between Devices**

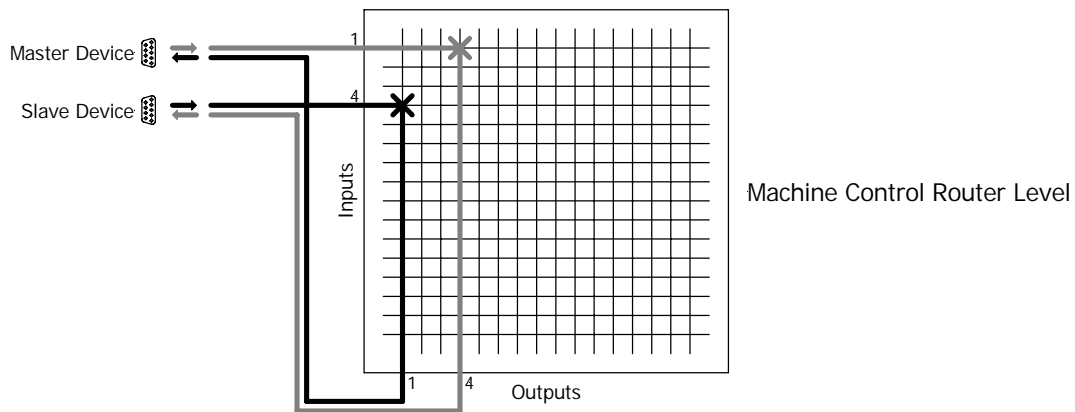
## Machine Control Routing - How It Works

A machine control router eliminates the need for complicated cabling between RS422 ports of devices, automatically switching the sense of connections to accommodate different master / slave connections.

In a typical routing scenario, several devices are connected to a machine control router, with RS422 connections switched using a control panel or a virtual controller.

To establish an RS422 connection between two devices, two switches are required; one to connect the master device's Tx pair to the slave's Rx pair and secondly a reciprocal switch for connecting the slave device's Tx pair to the master's Rx pair.

Once this connection is established, the devices communicate via the RS422 connection until it is necessary to change the master / slave relationship in the system.

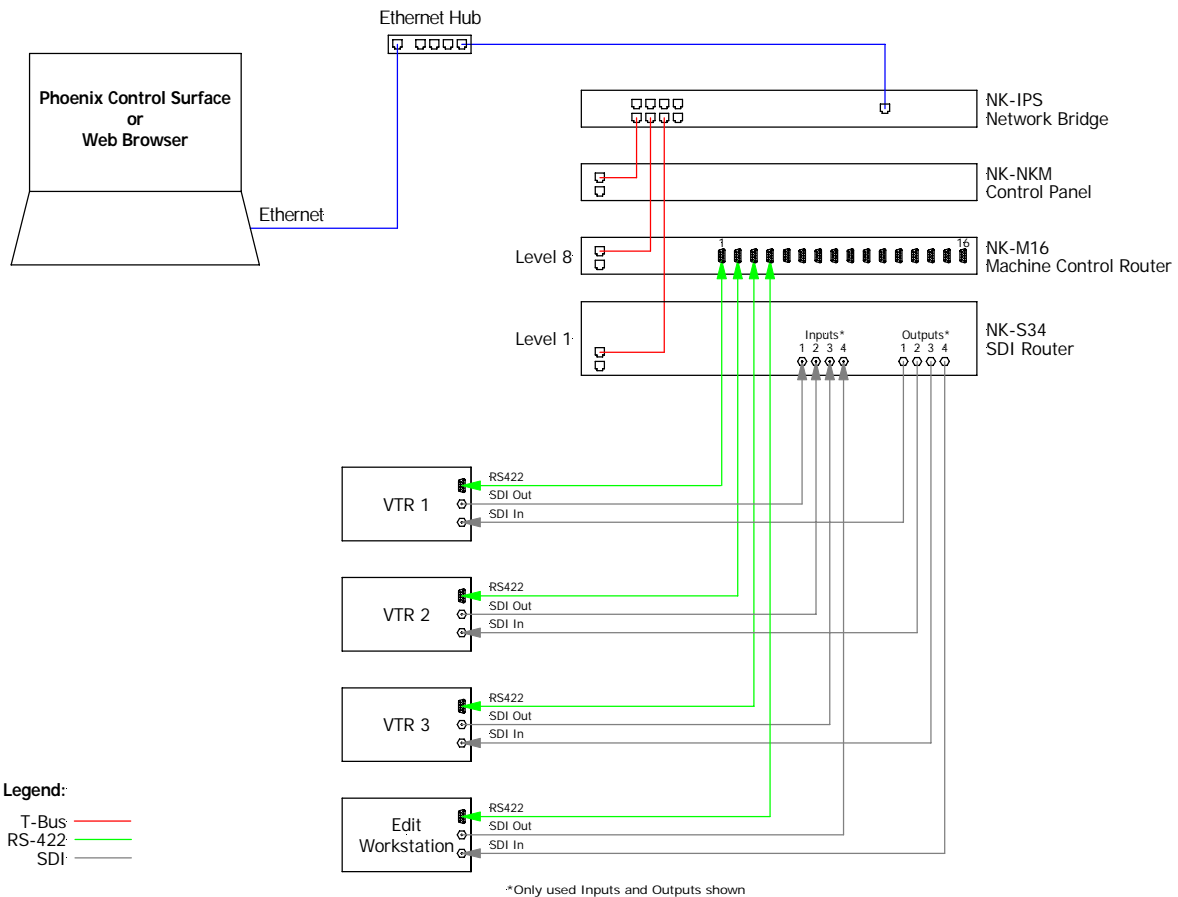


**Machine Control Crosspoint Switching**

## Configuring an NK Series System for Machine Control Routing

Configuration of NK Series devices for machine control routing requires an NK-IPS Network Bridge and a computer with web browser or Phoenix Control Surface software.

Consider the following machine control routing system example:



### ***Machine Control Routing System Example***

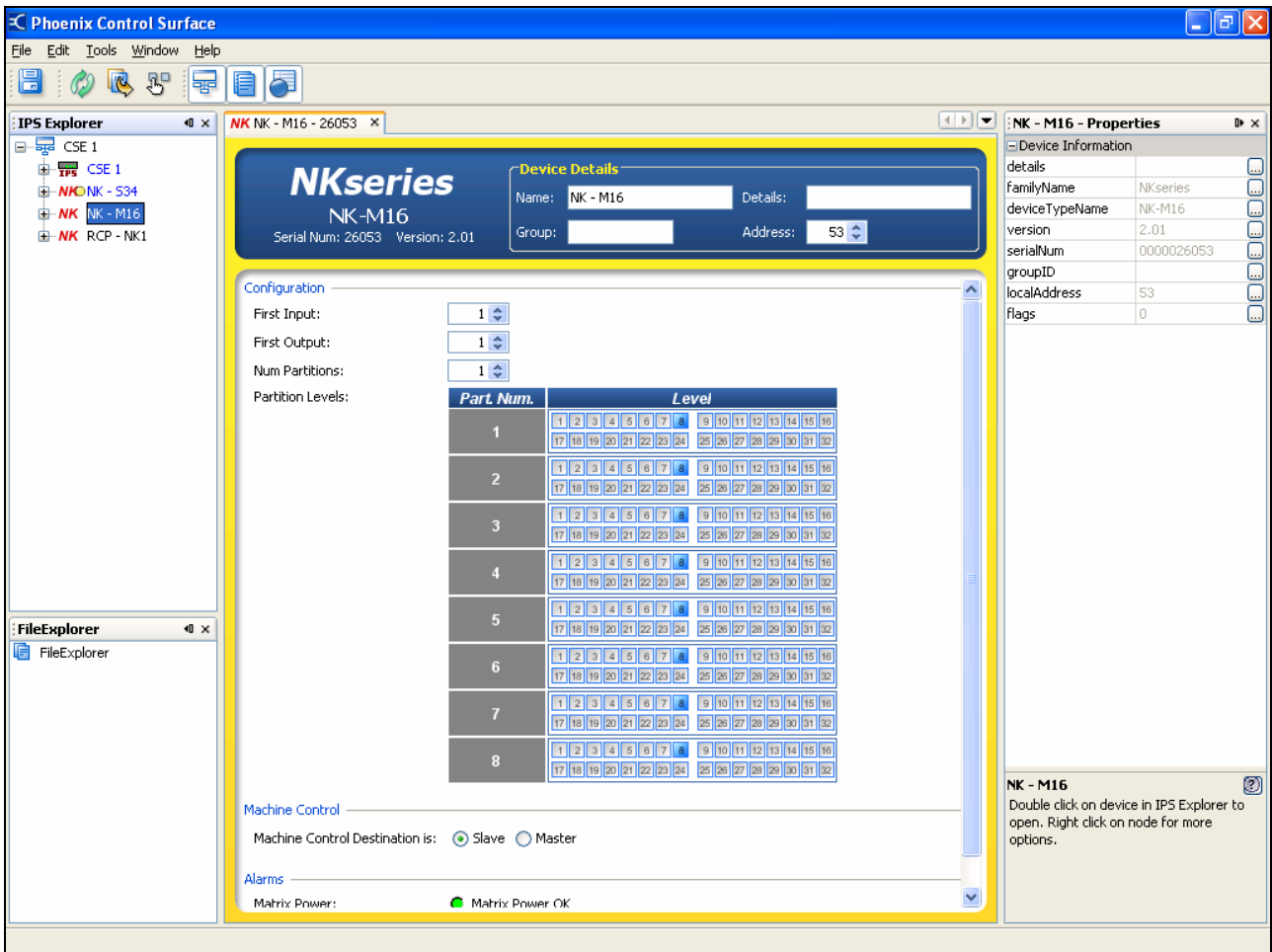
A video production suite is equipped with an Edit Workstation and 3 VTRs with all devices connected to an NK-S34 SDI router and an NK-M16 machine control router.

We wish to set up the system to route SDI signals between the Edit Workstation and VTRs, using machine control to control the transfer of SDI signals between devices.

First we configure the system for machine control routing as follows:

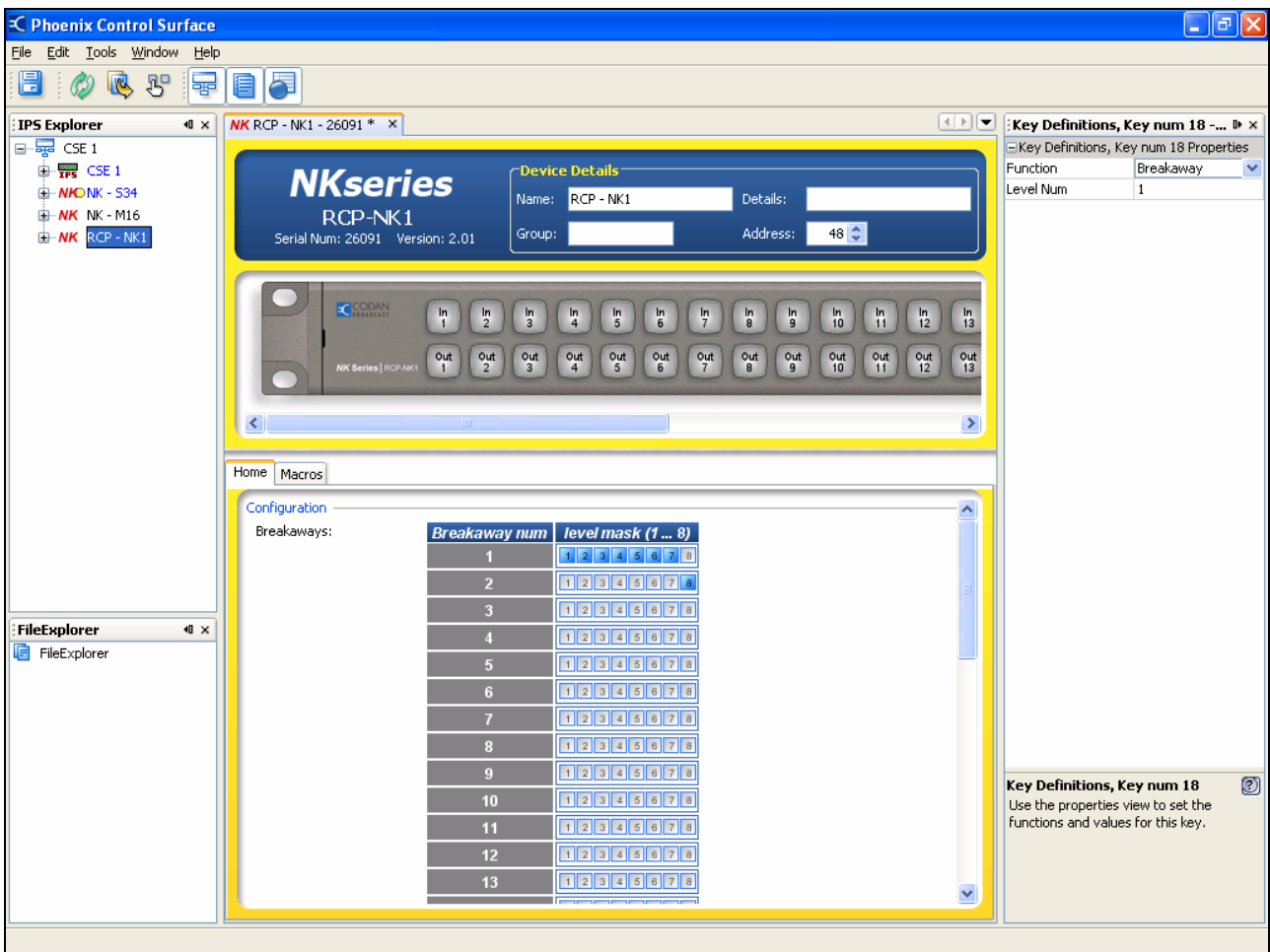
For the NK-M16 Machine Control Router:

1. From the **Partition Levels** section of the configuration window, set the router level (default for machine control is level 8).
2. Select **Machine Control Destination is: Slave** or **Master**. (The default is Machine Control Destination is Slave - this means pressing a destination key on the control panel will select a device as a slave, while source keys will select a device as a master).

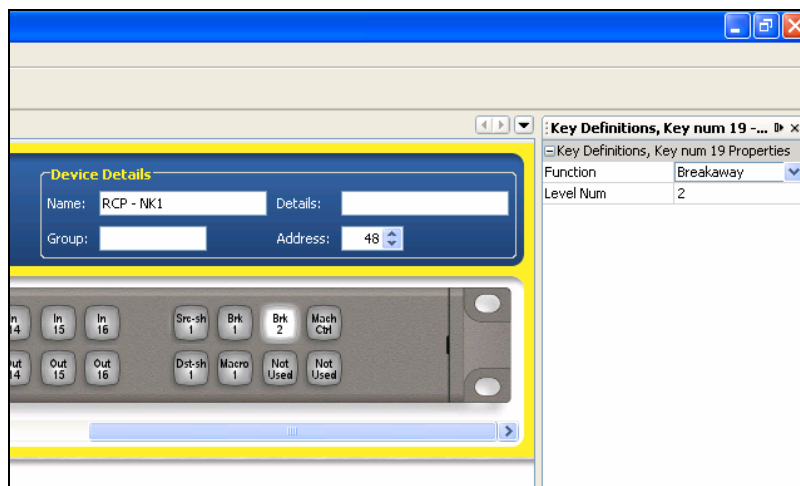


For the RCP-NKM Control Panel:

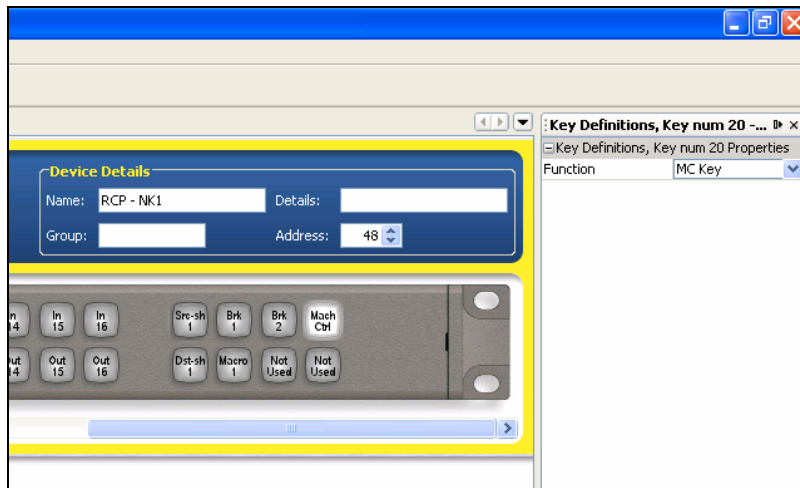
3. Configure Breakaway 1 as a tied breakaway to include all used levels, but NOT the machine control level. (Note: Unused levels should also be removed to avoid a breakaway warning on the control panel).
4. Configure Breakaway 2 with only the machine control level selected:



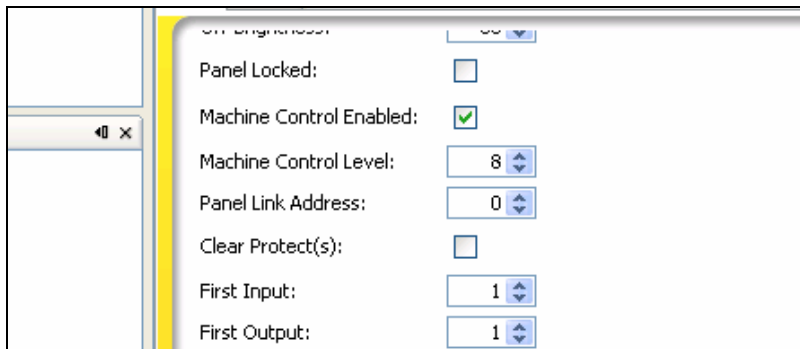
- Assign Breakaway keys on the control panel for Breakaways 1 and 2.



- Assign an MC key on the control panel (optional). This key is only necessary for the case of one master device controlling multiple slave devices, where it is necessary to temporarily to disable reciprocal switching until the last slave device is routed. Please refer to Example 4 following).



7. Select the **Machine Control Enabled** option and set the **Machine Control Level** in the control panel configuration:



## Making a Machine Control Switch from the Control Panel

Now that we have configured the system, we can set up machine control switches from the control panel.

Before any switches can be made from the control panel we need to select the machine control level and enable reciprocal switching from the control panel as follows:

1. Select Breakaway 2 - this selects the machine control level
2. Select the MC key – this enables reciprocal switching on the machine control level. (If there is no MC key then, provided the **Machine Control Enabled** option is selected in the control panel's configuration, machine control is always enabled and this step is not necessary).

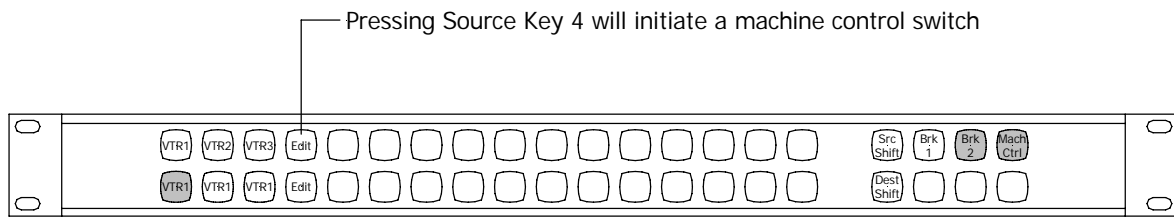
### Example 1

In the following example we will set up a machine control route with the Edit Workstation as the master and the VTR 1 as the slave:

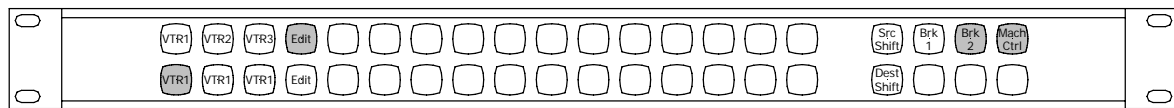
Source (Master)	Destination (Slave)	Description
Edit Workstation	VTR 1	Edit Workstation controls VTR 1

From the RCP-NK1 control panel:

- a) Select Destination key 1 – selects VTR 1 as the slave (assuming the NK-M16 router has been configured with **Machine Control Destination is: Slave**).

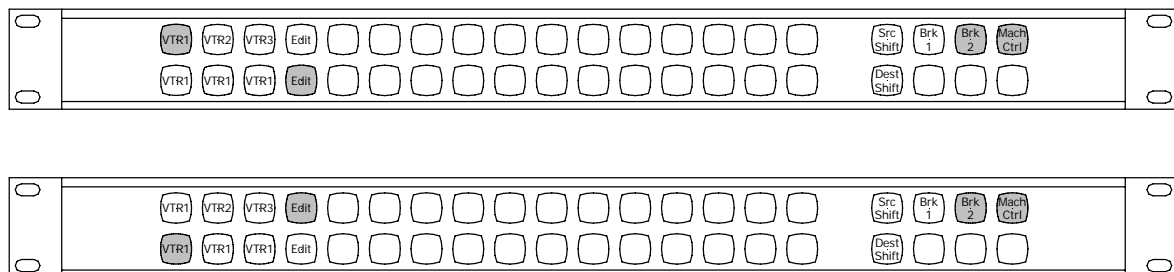


- b) Select Source key 4 – selects the Edit Workstation as the master. Note that the machine control switch does not take place until the source key has been pressed:



Once the source key is pressed, a bi-directional machine control connection is established with the Edit Workstation now acting as master, controlling VTR 1 via their common protocol. The router provides the RS-422 bi-directional electrical connection, carrying commands from the Edit Workstation to VTR 1, which in turn will acknowledge the request.

If we now press Destination key 4, the status shows a second connection exists with VTR 1 as the source and the Edit Workstation as the destination:



Alternating between VTR 1 and Edit Workstation destination keys reveals the bi-directional connection which exists between the two devices, with two crosspoints per machine control route. It is important to note that, while the control panel status indicates which ports are bi-directionally connected, the status cannot indicate the master-slave sense of the connection.

For this reason, **whenever a new machine control route is made, destination and source must both be pressed to force the sense of the connection even though the status indicates the connection already exists.**

## Example 2

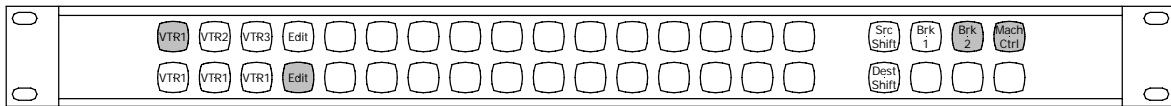
In the next example we will reverse the sense of the machine control route so that VTR 1 is the master and the Edit Workstation is the slave:

Source (Master)	Destination (Slave)	Description
VTR 1	Edit Workstation	VTR 1 controls Edit Workstation

From the RCP-NK1 control panel:

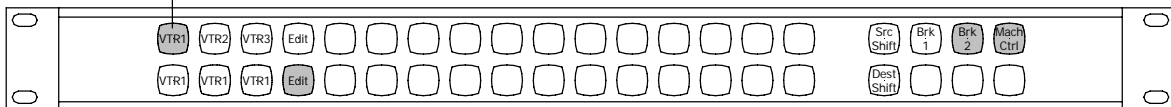
- a) Select Destination key 4 – selects Edit Workstation as the slave.

Note that the control panel now displays the router status with Destination key 4 **and** Source key 1 (VTR 1) selected. This is because a bi-directional connection already exists between the two devices (from the previous example).



- b) Select Source key 1 – selects VTR 1 as the master.

Although the status indicates the connection already exists, the Source Key 1 must be pressed to establish the master-slave sense of the connection.



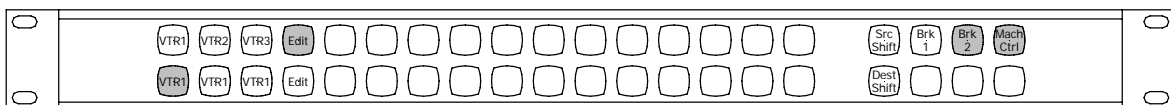
## Example 3 - Parking

The following example shows how devices can be *parked* to remove any machine control route:

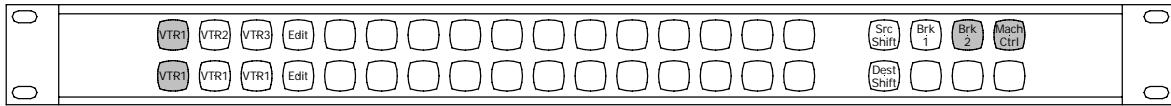
Source (Master)	Destination (Slave)	Description
None	None	VTR 1 and Edit Workstation parked

From the RCP-NK1 control panel:

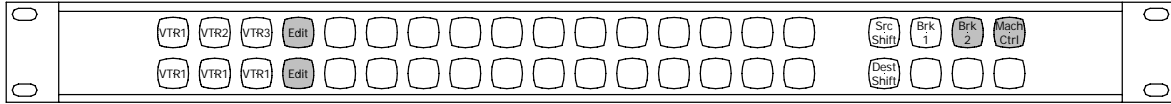
- a) Select Destination key 1 – selects VTR 1. The status shows a machine control route currently exists between VTR 1 and the Edit Workstation:



- b) Select Source key 1 – removes the route between VTR 1 and the Edit Workstation, effectively “parking” the devices so neither device has a machine control connection to any other device:



c) Selecting Destination key 4 reveals that the Edit Workstation is also parked:



In fact, selecting any source key other than Source key 4 at step b) above would automatically park the Edit Workstation, as its connection was broken to make the new route, and the parking is automatically performed as part of the machine control switching process.

### Example 4 – Multiple Slaves

The following example shows how one master device (the Edit Workstation) can control multiple slave devices (VTR1, VTR 2, VTR 3). This requires turning the reciprocal mode off using the MC key until the last slave is selected.

Source (Master)	Destination (Slave)	Description
Edit Workstation	VTR 1, VTR 2 , VTR 3	Edit Workstation controls multiple VTRs

From the RCP-NK1 control panel:

- Turn off the reciprocal switching mode using the MC key – while the MC key is off all routes will be non-reciprocal (in one direction only).
- Select Destination key 1, then Source key 4 – switches the Edit Workstation as the master to VTR 1 as the first slave (with no reciprocal switch for acknowledgement).
- Select Destination key 2, then Source key 4 - switches the Edit Workstation as the master to VTR 2 as the second slave (with no reciprocal switch for acknowledgement).
- Turn reciprocal switching mode back on using the MC key.
- Select Destination key 3, then Source key 4 - switches the Edit Workstation as the master to VTR 3 as the third and last slave, with reciprocal switching for acknowledgement).

The selection is done this way because a reciprocal switch would otherwise reset the previous slave selection. The final slave is the only switch that needs to be reciprocal because the master only requires an acknowledge from one slave device.

For single master to single slave switching, the MC key is left on, or alternatively, if a system never requires machine control routing with multiple slaves, the MC key is not required and reciprocal switching is always enabled on the machine control level.