INSTALLATION • OPERATION • MAINTENANCE

INSTRUCTIONS

TYPE CAM

PERCENTAGE DIFFERENTIAL RELAY

CAUTION Before putting relays into service, remove all blocking which may have been inserted for the purpose of securing the parts during shipment, make sure that all moving parts operate freely, inspect the contacts to see that they are clean and close properly, and operate the relay to check the settings and electrical connections.

APPLICATION

The type CAM Relay is a percentage differential relay of the induction type designed for the differential protection of a regulating transformer.

CONSTRUCTION AND OPERATION

The type CAM Relay has two electromagnets in the relay acting upon a common disc as shown in Figure 1. The rear electromagnet is the operating electromagnet, which tends to rotate the disc clockwise as viewed from the top and thus close the contacts. The front electromagnet furnishes restraint, tending to prevent the contacts from closing. Both electromagnets are energized from small transformers, T_O and T_R. These are saturating transformers so designed as to control the time curve as well as the percentage characteristic. Part of the magnetic circuit of the right-hand transformer, T_R, has an air gap in order to properly proportion the restraint circuit with respect to the operating circuit.

The relay element is provided with a time lever in order that the time of operation may be varied as required to provide satisfactory operation on magnetizing inrush. Two damping magnets are provided, one on either side of the disc, to slow the operation of the relay disc.

The operation indicator is a small solenoid coil connected in the trip circuit. When the coil is energized, a spring-restrained armature releases the white target which falls by gravity to indicate completion of the trip circuit. The indicator is reset from outside of the case by a push rod in the cover or cover stud.

The d-c. contactor switch in the relay is a small solenoid type switch. A cylindrical plunger with a silver disc mounted on its lower end moves in the core of the solenoid. As the plunger travels upward, the disc bridges three silver stationary contacts. The coil is in series with the main contacts of the relay and with the trip coil of the breaker. When the relay contacts close, the coil becomes energized and closes the switch contacts. This shunts the main relay contacts, thereby relieving them of the duty of carrying tripping current. The contacts remain closed until the trip circuit is opened by the auxiliary switch on the breaker.

CHARACTERISTICS

The typical operating characteristics of the relay are shown by Figures 3 and 4. As shown by Figure 3, the relay operates at a minimum of one ampere in the operating circuit when no current is flowing in the restraint circuit. At 5 amperes restraint, the operating current required is 5.75 amperes, representing a 15% unbalance. At higher restraint current values, the relay characteristic has a slight "flare" as indicated by the curve.

The time curve of the relay at the No. 5 time lever setting with no restraint current is shown by Figure 4. The time of operation is approximately proportional to the time lever setting.

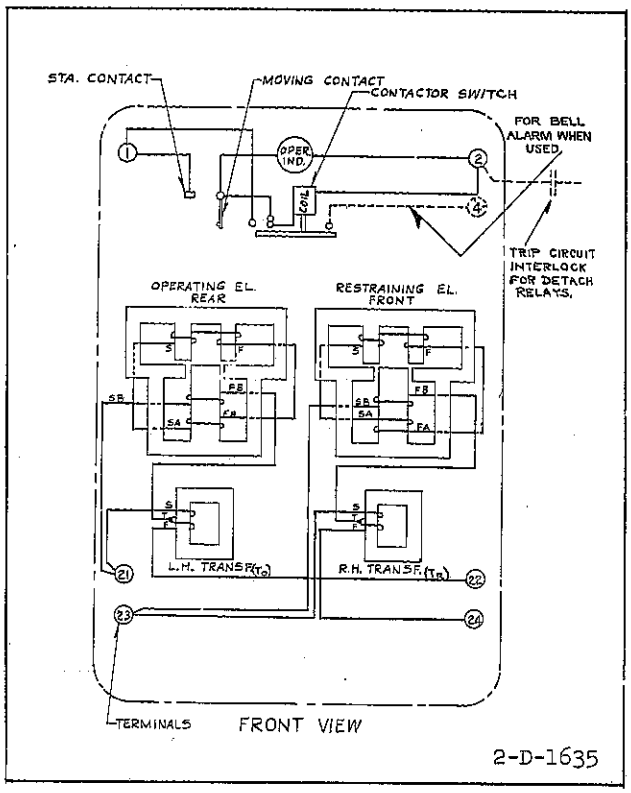

Fig. 1—Internal Schematic of the Type CAM Relay in the Standard Case.

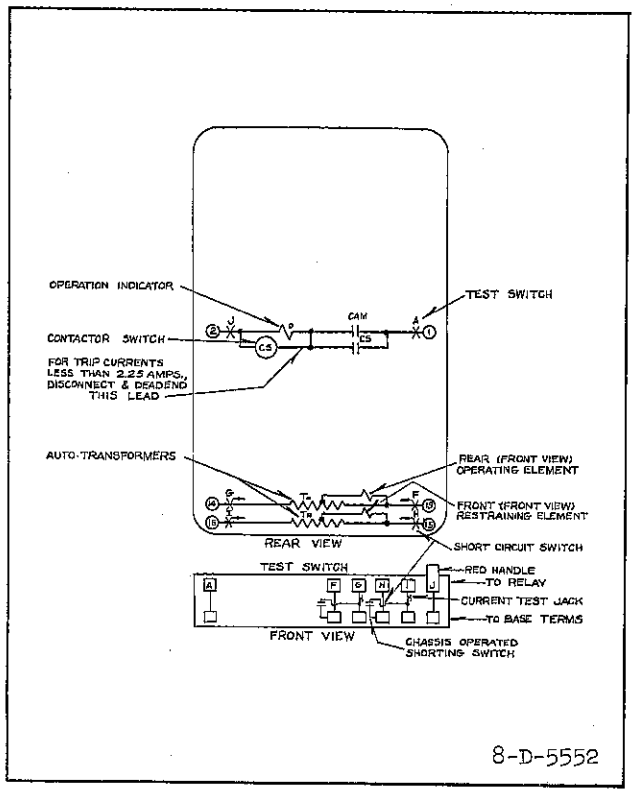

Fig. 2—Internal Schematic of the Type CAM Relay in the Type FT Case.

RELAYS IN TYPE FT CASE

The type FT cases are dust-proof enclosures combining relay elements and knife-blade test switches in the same case. This combination provides a compact flexible assembly easy to maintain, inspect, test and adjust. There are three main units of the type FT case: the case, cover, and chassis. The case is an all welded steel housing containing the hinge half of the knife-blade test switches and the terminals for external connections. The cover is a drawn steel frame with a clear window which fits over the front of the case with the switches closed. The chassis is a frame that supports the relay elements and the contact jaw half of the test switches. This slides in and out of the case. The electrical connections between the base and chassis are completed through the closed knife-blades.

Removing Chassis

To remove the chassis, first remove the cover by unscrewing the captive nuts at the corners. This exposes the relay elements and all the test switches for inspection and testing. The next step is to open the test switches. Always open the elongated red handle switches first before opening any of the black handle switches or the cam action latches. This opens the trip circuit to prevent accidental trip out. Then open all the remaining switches. The order of opening the remaining switches is not important. In opening the test switches they should be moved all the way back against the stops. With all the switches fully opened, grasp the two cam action latch arms and pull outward. This releases the chassis from the case. Using the latch arms as handles, pull the chassis out of the case. The chassis can be set on a test bench in a normal upright position for test as well as on its back or sides for easy inspection and maintenance.

After removing the chassis a duplicate chassis may be inserted in the case or the blade portion of the switches can be closed and the cover put in place without the chassis. The

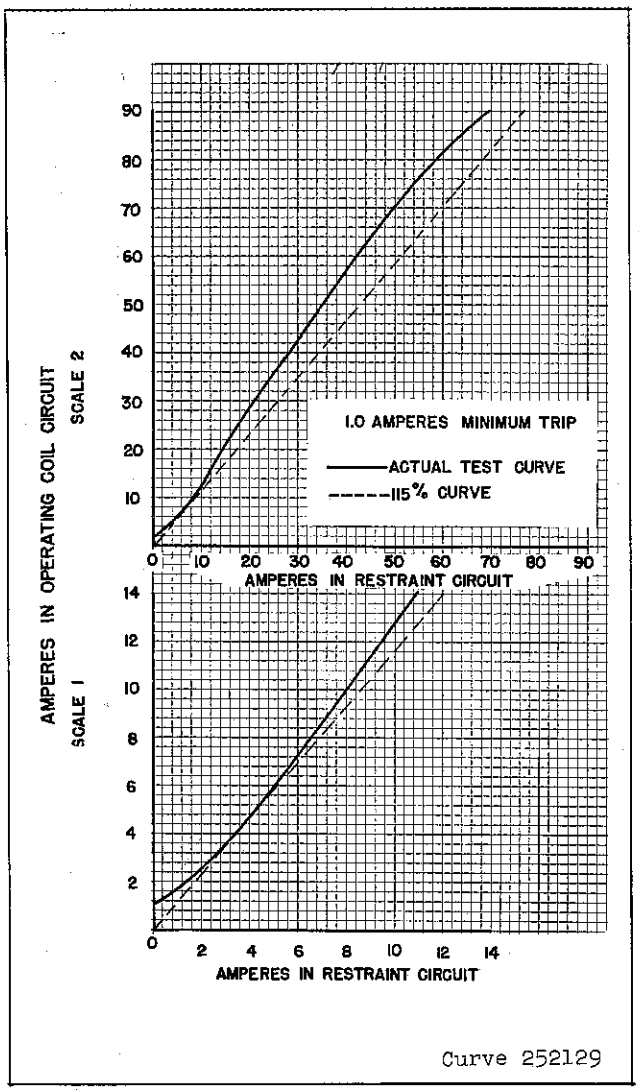

Fig. 3—Typical Operating Curves of the Type CAM Relay.

chassis operated shorting switch located behind the current test switch prevents open circuiting the current transformers when the current type test switches are closed.

When the chassis is to be put back in the case, the above procedure is to be followed in the reversed order. The elongated red handle switch should not be closed until after the chassis has been latched in place and all of the black handle switches closed.

ELECTRICAL CIRCUITS

Each terminal in the base connects thru a test switch to the relay elements in the chassis as shown on the internal schematic diagrams. The relay terminal is identified by numbers marked on both the inside and outside of the base. The test switch positions are identified by letters marked on the top and bottom surface of the moulded blocks. These letters can be seen when the chassis is removed from the case.

The potential and control circuits thru the relay are disconnected from the external circuit by opening the associated test switches. Opening the current test switch short-circuits the current transformer secondary and disconnects one side of the relay coil but leaves the other side of the coil connected to the external circuit thru the current test jack jaws. This circuit can be isolated by inserting the current test plug (without external connections), by inserting the ten circuit test plug, or by inserting a piece of insulating material approximately 1/32" thick into the current test jack jaws. Both switches of the current test switch pair must be open when using the current test plug or insulating material in this manner to short circuit the current transformer secondary.

A cover operated switch can be supplied with its contacts wired in series with the trip circuit. This switch opens the trip circuit when the cover is removed. This switch can be added to the existing type FT cases at any time.

Testing

The relays can be tested in service, in the case but with the external circuits isolated or out of the case as follows:

Testing In Service

The ammeter test plug can be inserted in the current test jaws after opening the knife-blade switch to check the current thru the relay. This plug consists of two conducting strips separated by an insulating strip. The ammeter is connected to these strips by terminal screws and the leads are carried out thru holes in the back of the insulated handle.

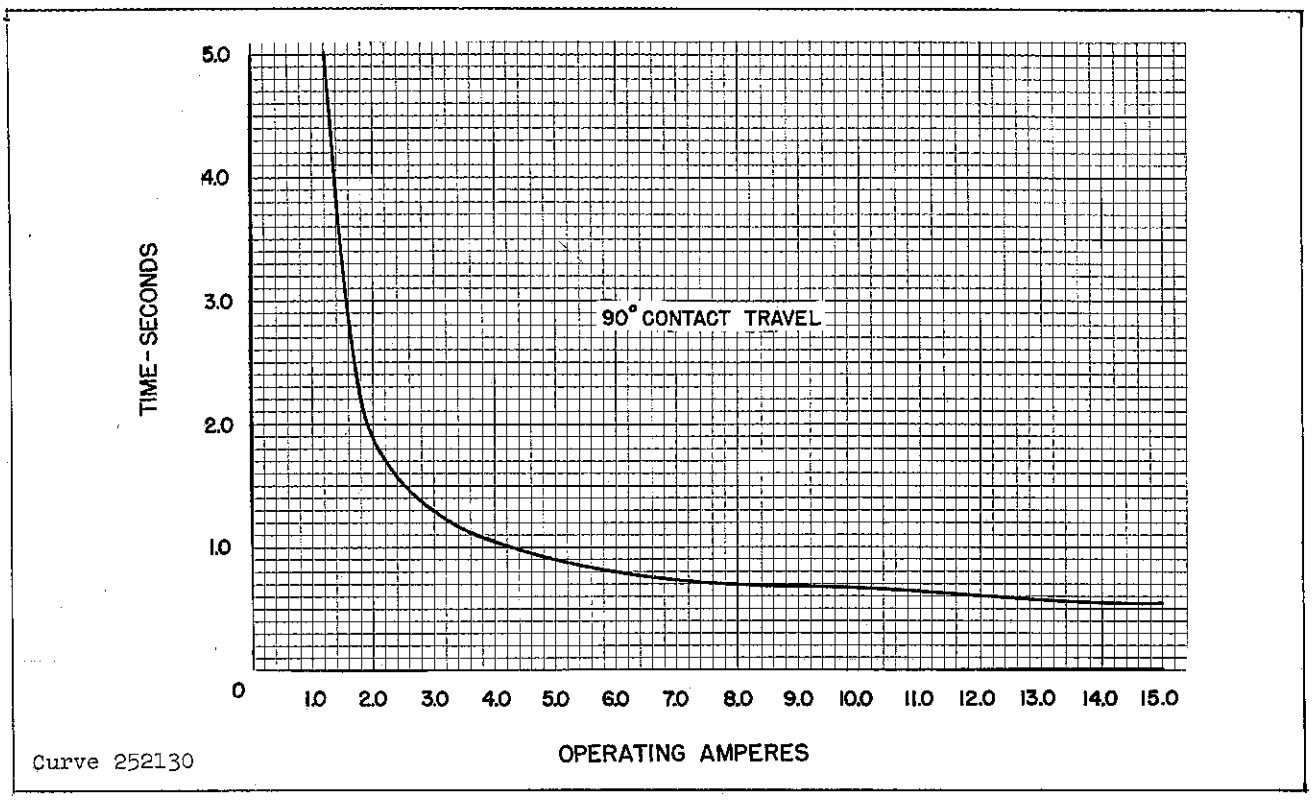

Fig. 4—Typical Time Curve of the Type CAM Relay.

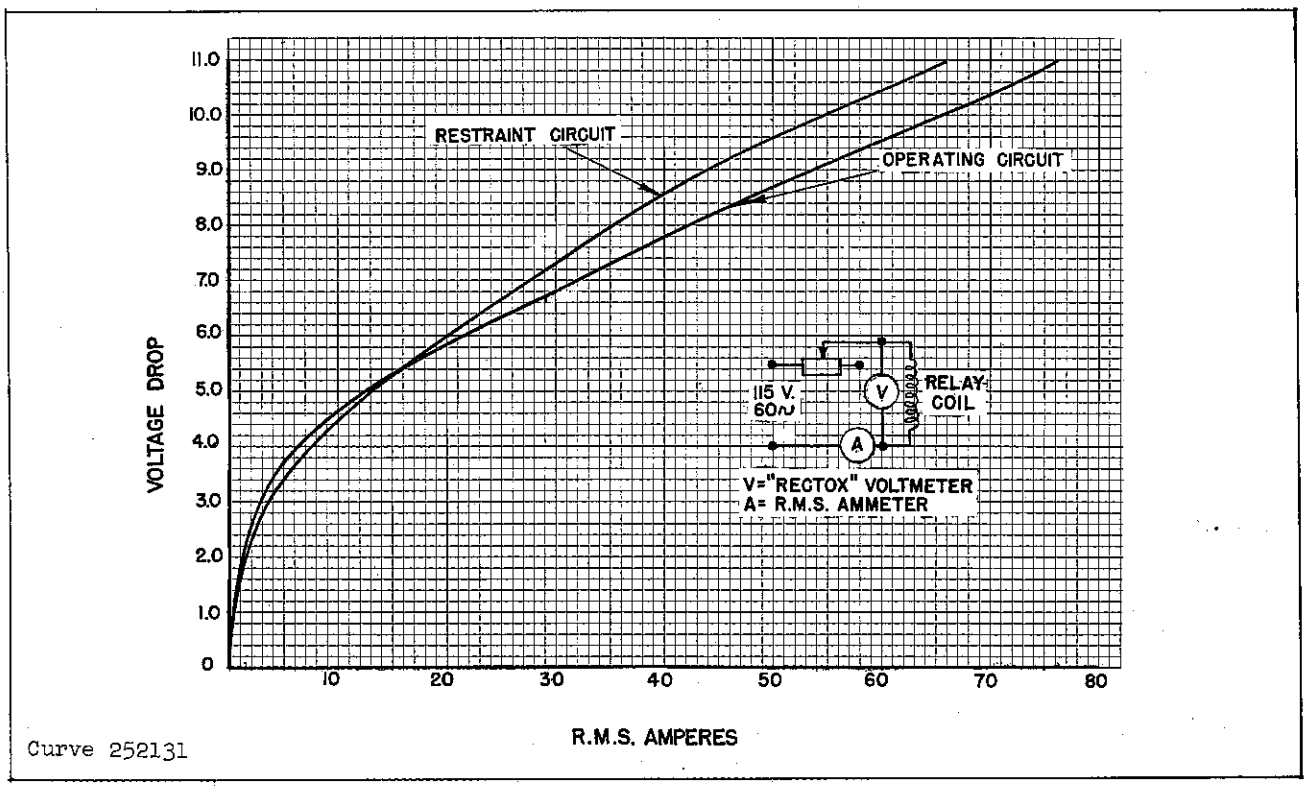

Fig. 5—Typical Burden Curve of the Type CAM Relay.

Voltages between the potential circuits can be measured conveniently by clamping #2 clip leads on the projecting clip lead lug on the contact jaw.

Testing In Case

With all blades in the full open position, the ten circuit test plug can be inserted in the contact jaws. This connects the relay elements to a set of binding posts and completely isolates the relay circuits from the external connections by means of an insulating barrier on the plug. The external test circuits are connected to these binding posts. The plug is inserted in the bottom test jaws with the binding posts up and in the top test switch jaws with the binding posts down.

The external test circuits may be made to the relay elements by #2 test clip leads instead of the test plug. When connecting an external test circuit to the current elements using clip leads, care should be taken to see that they current test jack jaws are open so that the relay is completely isolated from the external circuits. Suggested means for isolating this circuit, are outlined above under "Electrical Circuits."

Testing Out of Case

With the chassis removed from the base, relay elements may be tested by using the ten circuit test plug or by #2 test clip leads as described above. The factory calibration is made with the chassis in the case and removing the chassis from the case will change the calibration values by a small percentage. It is recommended that the relay be checked in position as a final check on calibration.

INSTALLATION

The relays should be mounted on switchboard panels or their equivalent in a location free from dirt, moisture, excessive vibration and heat. Mount the relay vertically by means of the two mounting studs for the standard cases and the type FT projection case or by means of the four mounting holes on the flange for the semi-flush type FT case. Either of the studs or the mounting screws may be utilized for grounding the relay. The electrical connections may be made direct to the terminals by means of screws for steel panel mounting or to terminal studs furnished with the relay for ebony-asbestos or slate panel mounting. The terminal studs may be easily removed or inserted by locking two nuts on the studs and then turning the proper nut with a wrench.

ADJUSTMENTS AND MAINTENANCE

The proper adjustments to insure correct operation of this relay have been made at the factory and should not be disturbed after receipt by the customer. If the adjustments have been changed, the relay taken apart for repairs, or if it is desired to check the adjustments at regular maintenance periods, the instructions below should be followed.

All contacts should be periodically cleaned with a fine file. S#1002110 file is recommended for this purpose. The use of abrasive material for cleaning contacts is not recommended, because of the danger of embedding small particles in the face of the soft silver and thus impairing the contact.

A diagram of test connections is given in Figure 6. This may be used for checking the minimum operating current as well as other points on the operating curve. The only adjustment which can be made is that for spring tension to control the minimum tripping point. The adjustment for other points on the curve has been made at the factory by varying the amount and type of punchings in the two small transformers, and should not be disturbed. In checking the minimum tripping point, see that the moving contact resets the full 180° to the No. 10 time lever position when the relay is totally deenergized. If it does not, look for foreign particles in the air gaps of the electromagnets and permanent magnets, or other sources of friction.

Contactor Switch

Adjust the stationary core of the switch for a clearance between the stationary core and

the moving core of 1/64" when the switch is picked up. This can be done by turning the relay up-side-down or by disconnecting the switch and turning it up-side-down. Then screw up the core screw until the moving core starts rotating. Now, back off the core screw until the moving core stops rotating. This indicates the points where the play in the assembly is taken up, and where the moving core just separates from the stationary core screw. Back off the core screw approximately one turn and lock in place. This prevents the moving core from striking and sticking to the stationary core because of residual magnetism. Adjust the contact clearance for 3/32" by means of the two small nuts on either side of the Micarta disc. The switch should pick up at 2 amperes d-c. Test for sticking after 30 amperes have been passed through the coil.

Operation Indicator

Adjust the indicator to operate at 0.25 ampere d-c gradually applied by loosening the two screws on the underside of the assembly, and moving the bracket forward or backward. If the two helical springs which reset the armature are replaced by new springs, they should be weakened slightly by stretching to obtain the 0.25 ampere calibration. The coil resistance is approximately 2.8 ohms.

ENERGY REQUIREMENTS

The burden of the relay is variable depending upon the amount of current flowing, and is best shown by Figure 5.

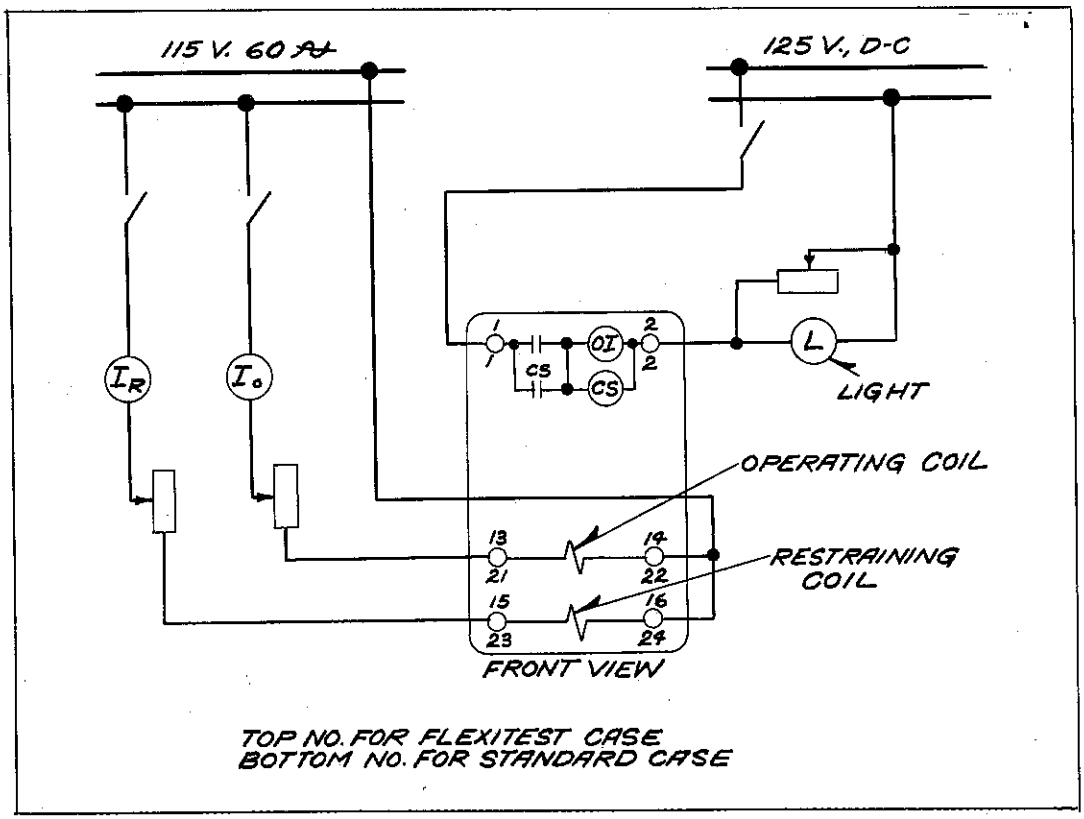

Fig. 6—Diagram of Test Connections of the type CAM Relay.

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