CROSSBAR SYSTEMS
NO. 3
MARKER CONNECTOR CIRCUIT

CHANGES

A. Changed and Added Functions

A.1 This circuit is arranged to function with the crossbar No. 3 200- to 1200-line application. Additional connector leads are added to accommodate the increased line capacity of the system.

A.2 The marker connector is changed to permit one additional incoming register to be added to each marker connector circuit.

B. Changes in Apparatus

B.1 Added

IRA	- 286M	Relay	- Fig. 8	
IRB	- 286M	Relay	- Fig. 8	
RS10	- AF136	Relay	- Fig. 5	Option T
IRA	- 180A	Network	- Fig. 8	
IRB	- 180A	Network	- Fig. 8	
RS10	- 185A	Network	- Fig. 5	Option T
W10	- 18AG	Resistor	- Fig. 5	Option T
X10	- 18AG	Resistor	- Fig. 5	Option T

D. Description of Changes

INCREASED LINE CAPACITY

D.1 The marker connector is changed to accommodate the increased line capacity of the crossbar No. 3 200- to 1200- line application. The leads associated with the added line blocks are added to the originating register and line, line switch, and connector circuits. Option W is added for this feature.

D.2 To accommodate the additional leads required per D.1, obsolete leads from the originating register circuit are designated X option, rated Mfr Disc.

ADDITIONAL INCOMING REGISTER CAPACITY

D.3 The marker connector is changed to permit one additional incoming register to be added in each connector circuit. Apparatus Fig. 8 and T option is added for this feature. Existing wiring designated V option rated Mfr Disc. is removed when App Fig. 8 and T option are added.

F. Changes in CD Section II

F.1 Under 1.02, change second sentence to read:...The operating ground for the RS relays in FS7 (line unit), FS6 (last incoming register), FS5 (intermediate incoming register), FS4 (first incoming register), FS3 (last originating register), and FS2 (intermediate originating registers), comes through the normal contacts of the RS relay in FS1 and/or preceding FS2 to FS6...

F.2 Under 1.08, change reference to RS9 to read RS10.

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DEPT 5245-GFC

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CROSSBAR SYSTEMS
NO. 3
MARKER CONNECTOR CIRCUIT

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SECTION I - GENERAL DESCRIPTION

1. PURPOSE OF CIRCUIT

1.01 The purpose of this circuit is to obtain access to a preferred marker via a preferred connector used by the line link circuit, the originating register circuit, and the incoming register circuit.

2. GENERAL DESCRIPTION OF OPERATION

2.01 In each marker connector there is one set of relays per FS1, FS2, or FS3 per originating register, one set of relays per FS4, FS5, or FS6 per incoming register, and one set of relays per FS7 per line link circuit. These relays are the ORA, ORB, ORC, ORD, ORE, and an RS relay per originating register; the IRA, IRB, and an RS relay per incoming register; the LUA, LUB, and an RS relay per line link circuit. The OR-, IR-, and LU- relays serve to provide paths for passage of information necessary for the completion of the call.

2.02 The RS relays are provided one per register or line link circuit and wired in a perference chain with other RS relays in the same connector. The function of the RS relays is to provide preference among the originating registers, incoming registers, and line link circuit which are competing for the same marker connector.

2.03 In each marker connector there is a preference control circuit consisting of a marker start (MS) relay and marker busy relay CB for each marker. The purpose of these relays is to give each connector access to the first idle marker depending on the point of connector access; when seized by the preferred connector, to make that marker busy to all other connectors; and to operate connector relays that will close all the necessary leads between the marker and the circuit requiring service.

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2.04 There are two start circuits in each connector and they are brought through the connector as STA and STB leads. The STA lead is used by the first preferred marker and the STB lead is used by the last preferred marker. The connector control circuit determines which start lead is to be used on a call. The start leads are used alternately. In case of delay or trouble, the alternate choice start lead is used. By this means a connector is sure of getting connected to a marker and the use of markers is spread among the connectors to obtain a reasonably equal distribution of load.

2.05 Each connector has a control circuit, which serves to equalize the service between connectors. This is done by gating the connector (holding the start leads open) after it is used, if another connector is requesting service at the same time. Therefore, a connector is not served a second time until the other connector calling for a marker is served once.

2.06 The control circuit also has timing functions. If a marker is not obtained within a given interval or is held for too long a time a transfer to an alternate choice marker is made.

SECTION II - DETAILED DESCRIPTION

1. OPERATION OF THE RS RELAYS

1.01 When an originating register, incoming register, or line link circuit require the services of a marker it closes battery to its ST lead toward the marker connector circuit. This closure may operate the RS relay associated with the requesting circuit, which may, in turn, operate the connector relays to close a path to the marker.

1.02 The RS relay of FS1 (first originating register) is assigned first preference in the RS chain and, therefore, has ground connected to its winding. The operating ground for the RS relays in FS7 (line unit), FS6 to FS4 (last to first incoming register), FS3 (last originating register), and FS2 (intermediate originating register) comes through the normal contacts of the RS relay in FS1 and/or preceding FS2 to FS6. This preference chain permits the RS relay in FS1 to operate at any time and that, while it is operated, no other RS relays in the chain may become operated.

1.03 Should the RS relay in FS7 be operated, followed by operation of the RS in FS1, the RS in FS2, which is adjacent to FS1 in the preference chain, would operate from the locking ground extended from FS1.

1.04 Should the RS in FS2 be operated, there would be no ground to operate the RS in FS3 to FS7.

1.05 Therefore, if an intermediate RS relay is operated, no RS relay following it in the preference chain may operate, while any RS relay preceding it may operate.

1.06 The RS1 and RS2 leads are composed of break-contacts of the RS relays, wired in multiple. This insures against malfunction of the connector due to dirty contacts in these leads.

1.07 In FS7, the TSTB lead extends ground to the test circuit indicating all RS relays in the marker connector are normal.

1.08 The TSTA lead of FS7 provides ground, from the test circuit, at relay RS9. Operation of RS9 relay extends ground, as a TST lead, via the marker connector MC relays to the marker.

2. OPERATION OF OR-, IR-, OR LU- RELAYS

2.01 When an RS relay operates, ground is applied to the associated ORA, IRA, or LUA relay from the normal contacts of the TC and TC1 relays in the control circuit, through normal contacts of preceding RS relays. This ground causes the associated ORA, IRA, or LUA relay to operate. The operation of the ORA, IRA, or LUA closes ground from the RS operated to other associated OR-, IR-, or LU- relays in the connector, causing them to operate. The battery for these relays is supplied from the requesting circuit, over the CBS lead.

2.02 When the OR-, IR-, or LU- relays have operated, the battery on the ST lead is extended to the preference control circuit over the STA and STB leads. This battery causes the MS relay in that circuit to operate, which, in turn, causes the marker connector relays to operate.

2.03 The operation of the marker connector relays causes operation of the TC and TC1 relays in the control circuit. This operation removes the ground from the RA and RB leads to FS1 to FS7. The ORA, IRA, or LUA relay is held operated through its own contacts to the RS operated to ground.

2.04 Should several RS relays be operated, the OR-, IR-, or LU- relays associated with FS1 or FS2 to FS6 nearest to FS1 in the chain of transfer contacts constituting the RA and RB leads between RS relays, would operate. Therefore, only one set of OR-, IR-, or LU- relays may be operated at one time.

2.05 After the RS relay has released, if any other RS relays are locked up and waiting, their associated OR-, IR-, or LU- relays will be operated in sequence, starting with the set nearest FS1, and operating one set at a time, in order, from FS1 toward FS7, until all waiting relays have been served.

2.06 The RA and RB leads consist of break-contacts of the RS relays wired in multiple. This insures against dirty contacts disabling the connector, either completely or in part.

3. SEIZURE

3.01 When the ORE, IRB, or LUB relay has operated, the battery on the ST lead is extended, as resistance battery, to the preference control circuit over the STA and STB leads. Depending upon whether the Z relay is operated or nonoperated one or the other of these leads is closed to the MS relay of FS8.

3.02 Assuming the Z relay normal, the STA lead is closed through the back contacts of the TC, Z, TRS, TRL, and TR relays. The preference is for the first marker and if the CB relay associated with the MS relay is normal, indicating that the marker is idle, the MS relay operates. If the CB relay is operated indicating a busy marker, the start lead is transferred to the next marker.

3.03 With the Z relay operated, start lead STB is closed through different contacts on the TC1, Z, TRS, TRL, and TR relays. The STB lead is connected to the MS relay in a preference chain for a marker different from that to which the STA lead is connected.

3.04 Upon operating, the MS relay releases the marker check relays MCK and MSK and operates the associated MA to MD relays of FS12. The check relays are normally operated through break-contacts of all MS relays associated with a marker, as a standing guard alarm.

DISCONNECT

3.05 When an originating register, incoming register, or line link circuit no longer requires the services of a marker, battery is removed from the start leads for disconnect. Removal of battery from the start leads releases the MS relay which releases the associated MA to MD relays of FS12.

4. MARKER BUSY CIRCUIT

4.01 When normal the CB relay indicates that the associated marker is idle and connects the start lead to the associated MS relay. When the marker is busy, the CB relay is operated and transfers the start lead to the CB contacts of the next marker circuit. If this marker is idle, its associated MS relay operated.

4.02 When a marker is seized, its MCB relay connects ground to the windings of all CB relays, to make the marker busy to all other connectors. When a CB relay operates, the MS relay for the marker associated with that connector is held operated by a make-contact of the MA relay in parallel with the break-contact of the CB relay. The MS relay break-contact in the start lead chain of MS relays prevents the start battery, which has operated one MS relay in the connector, from being passed on through the CB contacts and operating all other MS relays in the connector.

4.03 When a connector is in use, it locks operated all CB relays that are already operated. The object of locking the CB relays is to prevent the marker connector that has started to seize a marker other than its first choice marker from abandoning that marker and seizing a more preferred marker, should this more preferred marker become free before the connector is released.

4.04 The CB diode in the holding path of the CB relay is poled to permit the relay to lock up, but permits fast release when the locking ground is opened. Since the CB relays are released in parallel from a common holding ground, they would tend to kick into each other and slow down each others release. With the diode in the circuit, a CB relay always releases in series with a diode poled in the reverse direction (with a back resistance of several megohms) which gives the effect of an open circuit release.

5. OVERALL TIMING

5.01 An overall timing circuit is provided which sounds the major alarm if a request for a marker is not served within 5.9 to 7.0 seconds.

5.02 Upon the start of a call, ground is connected to the TM relay at the same time that battery is connected to the start leads for marker seizure. The TM and TM1 relays operate. The TM1 relay operated initiates the T2 time delay control circuit timing interval. If the T2 time delay

control circuit times out, relay CA is operated and locks in under the control of the test circuit. This sounds the major alarm. This will occur if the time-out is not interrupted before 5.9 to 7.0 seconds elapse.

5.03 In normal operation, a marker is seized before the 5.9-second interval has elapsed. A marker seizure is indicated by the operation of the MK relay, of FS9, from the operated marker connector MC relays. The MK relay in operating releases the TM and TM1 relays. During the release time of the TM and TM1 relays, the T2 time delay control circuit is recycled. The TM1 relay normal and the MK relay operated restarts the T2 time delay control circuit timing interval to time the release of the marker. If the marker releases the connector within 5.9 seconds or less, the T2 time delay control circuit will not operate the CA relay. However, should the marker exceed this time because of some trouble condition or should the marker connector relays remain operated due to a trouble, the T2 time delay control circuit will time out, operating the CA relay to operate the major alarm.

5.04 The MK relay releases at the end of the call upon the release of the marker connector MC relays and recycles the T2 time delay control circuit for the next call.

6. ALTERNATE MARKER PREFERENCE

6.01 The W and Z relays of FS9 provide means for shifting the marker preference by controlling the closure of the STA and STB start leads of FS8. For the first call the W relay operates while the marker is connected and the Z operates when the marker releases. On the next call, the W is released and the Z is held operated while the marker is connected. The Z releases when the marker is released. The Z relay, in operating or releasing, shifts the start lead preference. The W and Z relays in combination hold the TC or TC1 relays in order to prevent a false start on the start lead used on the previous call.

7. TROUBLE RELEASE

7.01 When the marker finds it necessary to disconnect because of some trouble, it grounds the CTR lead in FS9 operating the TRL relay which operates the TR relay. The TR relay locks independent of the TRL relay. Relays TR and TRL open the start leads thereby releasing the operated MS relay in FS8 which in turn releases the marker connector MA to MF relays. The release of the MC relays releases the MK relay, which in turn operates or releases the Z relay. The Z relay shifts the start leads as described in 6.01. The release of the marker connector MD relays also releases the TC and TC1 relays.

7.02 The release of the marker connector MC relays removes ground from the TRL relay to reclose the marker start lead. The release of relay TRL also removes the shunt from relay TR1. Relay TR1 operates and indicates to the second marker by ground or lead TR2 that the call is a second trial. Upon seizure of the second marker, the MK relay connects ground through contacts of the TR1 and TRL relays to the lower end of the winding of relay TR to shunt it down. The TR1 relay remains operated. If the second marker completes the call satisfactorily, the release of the MK relay releases relay TR1 and the next call is handled as a first trial call as indicated by ground on the TR1 lead.

7.03 Should the second marker on second trial also encounter trouble, it connects ground to the TRL lead of FS11. The grounded TRL lead causes the register or line link circuit to advance and releases the marker connector in the regular manner.

7.04 A failure of the TRL relay to release because of a trouble ground prevents seizure of a marker and holds the connector out of service. To prevent this, a circuit through the TRL relay is provided to hold the MK relay operated in order to initiate the T2 time delay control circuit and operate the major alarm should these relays remain operated for an abnormal period of time.

8. TRANSFER OF MARKER START LEADS

8.01 The T1 time delay control circuit, in FS9, functions to transfer the marker connector start leads, of FS8, to the alternate marker preference whenever an available marker is not obtained in approximately one second.

8.02 At the start of a call, the TM relay operates and closes ground to operate relay IM. The IM relay starts the T1 time delay control circuit. If a marker is not seized in approximately one second, providing markers are available as indicated by maintenance of ground through the CB relays, the

T1 time delay control circuit will time out and operate the TRS relay.

8.03 The TRS relay opens the start lead in use and closes the alternate one depending on the position of the Z relay. The TRS relay also releases the TM relay and holds the TM1 relay operated. The release of relay TM releases the IM relay to recycle the T1 time delay circuit. Relay TM1 is held operated to continue the 5.9-second overall timing by the T2 time delay control circuit before a marker is seized. The TRS relay locks operated through the TM1 relay.

8.04 When a marker is seized over the alternate start lead and relay MK operates, relay TM1 releases, but the TRS relay remains locked through relay MK. Relay TRS grounds the TRS lead to the marker to indicate that transfer has taken place. Upon release of the marker, relay MK releasing releases relay TRS.

9. MARKER CONNECTOR LEADS FOR TROUBLE RECORD - FS10

9.01 When a marker calls in the test circuit to leave a trouble record, ground is connected to the RGG lead. This ground operates the TRC relay in that particular marker connector with which the marker is associated through operated contacts of the marker connector MC relay. Relay TRC in operating, grounds the CN and RG leads to record the number of the marker connector and the position of the originating register, incoming register, or line link circuit in a particular connector.

10. TROUBLE AND IN-USE IDENTIFICATION LAMPS

10.01 A lamp is lighted at the test circuit over the C lead for each marker connector upon the operation of relay CA. Relay CA operates the MCTO lamp at the same time as it operates the major alarm to indicate a trouble condition.

10.02 A lamp is lighted at the test circuit over the M lead for each marker connector upon the operation of relay MK. Relay MK closes the MC lamp circuit to indicate normal connector function and marker seizure.

11. CHECK FOR FALSE GROUND ON LEADS MRL AND TRL

11.01 With the marker connector circuit normal, the secondary winding of relay CA is connected to leads MRL and TRL through break-contacts of the GT relay. If any one of these leads is grounded falsely while the marker connector is normal, relay CA operates, locks, sounds the major alarm, and lights the MCTO lamp at the test frame test circuit. This lamp indicates, over the C lead, the connector involved. This test is made to prevent a trouble ground on any one of these leads from prematurely disconnecting the originating register, incoming register, or line link circuit without leaving a trouble record. When the trouble is cleared, the CA relay is released by the alarm sending circuit AR relay, under control of the test circuit MAR key. During a call the GT relay, of FS11, is operated from the IRB, ORE, or LUB relays of FS12 and from the MK relay. Relay GT removes the check from the leads until the connector is again completely normal.

12. CONNECTOR MAKE BUSY

12.01 Means are provided to make a marker busy to a connector by inserting a make-busy plug in the test frame test circuit. This grounds the CB lead and operates the CB relay to pass the start lead to the next number.

SECTION III - REFERENCE DATA

1. WORKING LIMITS

1.01 None.

2. FUNCTIONAL DESIGNATIONS

2.01 Relays

Designations	Meaning
CA	Connector Alarm
CB-	Connector Busy
GT	Ground Test
IM	Idle Marker
IRA, IRB	Incoming Register Connector
LUA, LUB	Line Link Connector
MA to MF	Marker Connector
MK	Marker Seizure Check
MS-	Marker Start

Designations	Meaning
ORA to ORE	Originating Register Connector
RS	Preference
TC	Traffic Control (STA Start)
TC1	Traffic Control (STB Start)
TM	Timing
TM1	Timing
TR	Trouble Release
TR1	Trouble Release
TRC	Trouble Recorder Connector
TRL	Trouble Release
TRS	Transfer Start Lead
W	Marker Start Lead Steering
Z	Marker Start Lead Steering

3. FUNCTIONS

3.01 To distribute the preference for markers in the various marker connectors.

3.02 To prevent reverting the call to a more preferred marker, which becomes available after the call in the marker connector has been assigned to a less preferred marker.

3.03 To prevent more than one marker connector from being connected to a marker at the same time.

3.04 To provide means for advancing the marker preference in a marker connector when the preferred marker is seized by some other marker connector.

3.05 To provide a marker connector control circuit whose functions are:

(a) To prefer the use of different markers on successive calls through the marker connector. The start lead preference is shifted on successive calls through a W and Z relay combination.

(b) To start an overall timing circuit functioning upon the start of a call and to sound a major alarm at the end of a specified interval if the call is not satisfied. The alarm locks in under control of a key at the maintenance center.

(c) To start a timing circuit whose purpose is to switch the marker connector preference of a marker to the alternate start lead, if the call is not connected to an available marker within a specified interval. The timing is stopped if all markers are busy. Indication of the shift is transmitted to the markers for recording purposes.

(d) To recycle the overall timing circuit after a marker is seized and start retiming for a disconnect by the marker.

(e) To recycle the overall timing circuit between calls.

(f) To provide means for recording a second trial signal from a marker, releasing that marker, and steering the call into another idle marker.

3.06 To provide means for detecting trouble grounds on the MRL and TRL leads. A locked in major alarm is sounded if ground is present.

3.07 To provide means for making a marker busy to any marker connector in which it appears.

3.08 To provide control of test circuit lamp indications of marker connector trouble condition and normal connector functions.

3.09 To provide means for closing circuits to the test circuit whose purpose is to record the number of the marker connector and the position of the originating register, incoming register, or line link circuit in a particular connector.

3.10 To provide means for connecting an originating register, incoming register, or line link circuit to a marker.

3.11 To provide an indication to the test circuit when any marker connector is normal.

4. CONNECTING CIRCUITS

4.01 When this circuit is listed on a key-sheet, the connecting information thereon is to be followed.

(a) Alarm Circuit - SD-26393-01.

(b) Alarm Sending Circuit - SD-26442-01.

(c) Incoming Register Circuit - SD-26386-01.

(d) Line, Line Switch, and Connector Circuit - SD-26382-01.

(e) Marker Circuit - SD-26384-01.

(f) Originating Register Circuit - SD-26385-01.

(g) Test Circuit - SD-26411-01.

(h) Time Delay Control Circuit - SD-94820-01.

5. MANUFACTURING TESTING REQUIREMENTS

5.01 This circuit shall be capable of performing all the functions listed in this Circuit Description and meeting the requirements listed in the Circuit Requirements Tables.

6. ALARM INFORMATION

6.01 If markers are available and the TC and TC1 relays are released, and the call is not served in approximately one second, it is transferred to the next marker in the preference chain. When a transfer is made, a transfer indication is given to the marker, which in turn causes a trouble record to be made, the minor alarm to sound, and a line-up lamp at the test frame to light.

6.02 If a call is not served by a marker connector in approximately seven seconds, and a marker is not available, a major alarm is sounded.

6.03 If a marker is held by a marker connector for approximately seven seconds, the marker connector sounds the major alarm. Under this condition the marker timing circuit functions, causing the marker to give a trouble release to the marker connector on a first trial basis and leaving a trouble record indicating a first trial failure. The lamps and keys associated with the time alarm circuits for markers are located at the marker frame.

6.04 In response to a major alarm, momentarily operating the master alarm release (MAR) key should silence the alarm. If the alarm is not silenced and a MTCO lamp remains lighted, the trouble may be caused by a steady ground on the MRL or TRL leads.

6.05 If a marker connector fails to connect to a marker, the trouble may be caused by a failure of the transfer feature to function.

6.06 If a marker connector fails to release a marker, the marker times out and causes a trouble record to be taken. The trouble may be caused by failure of the marker to disconnect battery from the MS relay or by the failure of the TRL relay of the marker connector to perform its functions.

6.07 All the keys and lamps associated with the time alarm circuits for the marker connectors and the make-busy jacks and lamps associated with markers, marker connectors, and registers are located on the test frame.

7. TAKING EQUIPMENT OUT OF SERVICE

7.01 Complete Marker - A marker may be made busy to a marker connector by inserting a 329A plug into the associated MCMB jack at the test frame or by means described in the test circuit CD and remote make-busy and restore control circuit CD.

7.02 Relay CA - Blocking this relay nonoperated prevents sounding the major alarm when the connector times out waiting for a connection to a marker or the release of a marker or when there is a trouble ground on the MRL or TRL lead.

7.03 Relay CB - Make busy the associated marker as described in 7.01. Insulate the 6 break-contact and short circuit the 6 make-contact of the CB- relay to be removed from service.

7.04 Relay GT - Blocking this relay nonoperated prevents sounding the major alarm when there is trouble ground on the MRL or TRL lead.

7.05 Relay IM - Blocking this relay nonoperated prevents the transfer of start leads on failure to obtain a marker within approximately 1 to 2 seconds.

7.06 Relays IRA, IRB - Make busy the associated incoming register by operating the related IRMB key at the test frame.

7.07 Relays LUA, LUB - Make busy both markers in the same marker connector by means described in 7.01. Since this denies service to every line of the associated line link circuit, great discretion should be exercised in this matter.

7.08 Relays MA to MF - Make busy the associated marker as described in 7.01.

7.09 Relay MK - Blocking this relay nonoperated prevents recycling the T2 time delay control circuit when the marker is connected.

7.10 Relay MS - Make busy the associated marker as described in 7.01. Short circuit the 6 break-contact of the MS- relay to be removed from service.

7.11 Relays ORA to ORE - Make busy the associated originating register by operating the related ORMB key at the test frame.

7.12 Relay RS - If the RS relay is associated with an incoming or originating register, make busy the register as described in 7.06 or 7.11. If the RS relay is associated with the line link circuit, make busy by means described in 7.07 and 7.01. Care must be exercised to avoid opening the chain circuit through the transfer contacts of the RS relay. If this precaution is not observed, other circuits served by this connector will be interfered with.

7.13 Relays TC and TC1 - Blocking these relays nonoperated prevents full operation of the traffic control feature and some one marker connector may therefore be delayed unduly in seizing a marker.

7.14 Relay TM - Blocking this relay nonoperated prevents full operation of the traffic control feature and prevents the T2 time delay control circuit timing for seizure of a marker.

7.15 Relay TM1 - Blocking this relay nonoperated prevents the T1 and T2 time delay control circuit timing for seizure of a marker.

7.16 Relay TR - Blocking this relay nonoperated prevents the release of the marker and marker connector on trouble release until the marker times out.

7.17 Relay TR1 - Blocking this relay nonoperated prevents giving the marker a second trial indication.

7.18 Relay TRC - Blocking this relay nonoperated prevents passage of trouble record information from the associated marker connector.

7.19 Relay TRL - Same as 7.16.

7.20 Relay TRS - Same as 7.05.

7.21 Control Relays W and Z - Block W nonoperated to remove either relay from service. This will prevent changing marker preference on alternate calls.

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