

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
WITH "TOUCH-TONE" TYPE D
CONVERTER TRUNK AND LINK

CHANGES

B. Changes in Apparatus

B.1 Added

AL7 relay AG24-FS2, App. Fig. 3.

D. Description of Changes

D.1 AL7 relay was added to FS 2&4 and App. Fig. 3.

D.2 AL1 relay contact 9 was added to FS4.

F. Changes in CD Sections

F.1 In Section II, 2.01, the fourth sentence should end with "... in the switch preference chain." and the fifth sentence should read "Ground is also applied to the switch preference chain from the break contact of the last SW relay."

F.2 In Section II, 4.01, add the following paragraph under the functions of the AL1 relay "(e) operates the slow-release AL7 relay." and change the second sentence on Page 4 from "the SWA - and AL2 relays ..." to "the SWA -, AL2 and AL7 relays ...".

F.3 In Section III, 2.01, designation "AL1-6" is changed to read "AL1-7".

BELL TELEPHONE LABORATORIES, INCORPORATED

Dept 5245-GFC
WECO Dept 5151-GMD-WEA

NOTICE

This document is either
AT&T - Proprietary, or WESTERN
ELECTRIC - Proprietary

Pursuant to Judge Greene's Order of August 5, 1983,
beginning on January 1, 1984, AT&T will cease to use
"Bell" and the Bell symbol, with the exceptions as set
forth in that Order. Pursuant thereto, any reference to
"BELL" and/or the BELL symbol in this document is here-
by deleted and "expunged"

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
CONVERTER TRUNK AND LINK

CHANGES

D. Description of Changes

D.1 LKTO diode is added to the LKTO lead to prevent a service interruption in the event that the -48 fuse operates in the Misc. Circuit.

D.2 LKTO diode is added to App. Fig. 3.

D.3 CADs 1, 2, 4 and 5 are changed to correct an open condition in the cabling between crossbar switch select magnets and associated converters.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-HNS
WECO DEPT 5151-GMD-WEA

STEP-BY-STEP SYSTEMS
NO. 1, 350A, 355A OR 35E97
CONVERTER TRUNK AND LINK

CHANGES

D. Description of Changes

- D.1 The title box is changed to include the 35E97 system.
- D.2 Option Z wiring is added to FS1 for connection in a 35E97 CDO.
- D.3 FS3, FS4, and FS5 are changed to correct minor errors.
- D.4 Notes 104 and 105 are added.
- D.5 Equipment Note 202 is added, and CADs 7 through 10 are changed to reflect changes noted in D.1 to D.3.
- D.6 CADs 1 through 6 are changed to agree with WECO Manufacturing drawings.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT 5245-LCB
WECO DEPT 5151-JPW-WEA

STEP-BY-STEP SYSTEMS
NO. 1, 350A OR 355A
WITH TOUCH-TONE TYPE D
CONVERTER TRUNK AND LINK CIRCUIT

<u>TABLE OF CONTENTS</u>	<u>PAGE</u>
<u>SECTION I GENERAL DESCRIPTION</u>	1
1. <u>Purpose of Circuit</u>	1
2. <u>General Description of Operation</u>	1
<u>SECTION II - DETAILED DESCRIPTION</u>	1
1. <u>Trunk Preference and Seizure</u>	1
2. <u>Switch Preference and Select Magnet Control</u>	2
3. <u>Converter Allotter Operation</u>	3
4. <u>Alarm and Release</u>	3
Work Timer	3
RES1 and RES2 Relay Check	4
Two Timeout Alarm	4
5. <u>Lamp Latching Circuit</u>	5
<u>SECTION III - REFERENCE DATA</u>	5
1. <u>Working Limits</u>	5
2. <u>Functional Designations</u>	5
3. <u>Functions</u>	5
4. <u>Connecting Circuits</u>	6
5. <u>Manufacturing Testing Requirements</u>	6
6. <u>Alarm Information</u>	6

SECTION I - GENERAL DESCRIPTION

1. Purpose of Circuit

1.01 This circuit is for use in Step-by-Step offices that serve customers having TOUCH-TONE station sets. A connection between the Converter Circuit and the Line Finder, First Selector pair is provided when a trunk is seized by a grounded Line Finder sleeve at the start of a call. There is a maximum of 140 trunks in this circuit,

20 trunks per crossbar switch, with a maximum of 7 switches. A maximum of 12 converters can be served by this circuit.

2. General Description of Operation

2.01 Trunks gain access to Converters through Switch Preference, Gating and Converter Allotter Circuits. Trunks within a switch are served one at a time, and when competing are served according to their position in the trunk preference chain.

2.02 Switches are arranged in a chain which allows them to recognize a demand for service if the gating circuit is normal or there are no other bids for service in any of the higher numbered switches. Select magnets associated with the same converter are arranged in a preference chain allowing lower numbered switch's select magnets to have preference over higher numbered switch's select magnets.

2.03 For any switch the associated select magnets gain access to converters via the converter allotter CA and CS relays. The CA relays provide the converter available function and the CS relays provide the converter seized function.

2.04 A one second timer is provided to time the set up of the bid for a converter. If the time to set up a call exceeds one second, the timer times out, releasing the bid in the converter allotter circuit and advances the allotter to the next idle converter. For trouble recording purposes the lamp latching circuit causes the Trunk Number, Switch Number and Converter Number to be displayed by Light Emitting Diodes (LED's) in the Miscellaneous Circuit when a timeout occurs.

SECTION II - DETAILED DESCRIPTION

1. Trunk Preference and Seizure

1.01 When a line finder is started by a demand for service, ground is extended over the sleeve lead to the winding of the associated TP- relay. The TP- relay operating battery is controlled by the switch relay SW-. With the sleeve lead grounded and the SW- relay normal the TP- relay operates and holds to battery through its own make contact. The operation

of a TP relay causes the SW- relay to operate. When the SW- relay operates the operating battery for the TP relays is removed, preventing TP relays not previously operated from operating. Thus preventing recognition of subsequent starts in the associated switch, until the link connection is established for each of the seized trunks within that switch.

1.02 Trunks that have an operated TP relay are served by a preference chain with the lowest numbered trunk having an operated TP relay being served first. When an idle converter is seized by the converter allotter the associated switch select magnet operates, extending ground from its off normal contact through the lowest operated TP relay make contact and a break contact of the associated TB relay to the winding of the associated hold magnet causing it to operate.

1.03 With the select and hold magnet operated the switch crosspoints close, connecting the subscriber tip and ring to the converter and connecting the converter "C", fundamental tip and fundamental ring leads to the trunk. After the trunk is connected to a converter the trunk seize TS relay operates from ground on the converter "C" lead. Relay TS operated performs the following functions:

- (a) Opens tip and ring leads.
- (b) Provides holding ground for the hold magnet when the TB relay operates.
- (c) Extends ground from the sleeve lead to the TB relay causing it to operate.

1.04 Relay TB operated is held from ground on the sleeve lead through its own make contact and performs the following functions:

- (a) Opens the operate path of the hold magnet.
- (b) Provides a hold path for the TS relay when the TP relay releases.
- (c) Transfers holding ground for the TP relay from the sleeve lead to the TP's own make contact and the off normal contact of the operated select magnet.
- (d) Completes the operate path for the gate release relays GTR and GTRL.

1.05 With the GTR and GTRL relays operated the converter allotter releases the associated select magnet. With the select magnet released, ground is removed from the TP relay causing it to release. With the TP relay released, ground will be extended from the off normal contact of the

next operated select magnet, via the break contact of the TP relay that just released and the make contact of the next highest operated TP relay to the winding of the associated hold magnet causing it to operate, cutting through leads from the next trunk to the next converter. The operation of the TS and TB relays are the same. Thus trunks within a switch are served one at a time with lower numbered trunks having preference over higher numbered trunks.

2. Switch Preference and Select Magnet Control

2.01 Switch preference relays SW- and SWS- are provided for each crossbar switch. When no demand for service exists in any of the switches all the SW and SWS relays are normal. With the SW and SWS relays released a resistance battery is extended to the winding of the gating relay GT through, a series of break contacts of the SW relays, causing GT to operate. The GT relay operated extends ground from one of its make contacts to a break contact of the first SW relay in the switch preference chain from the break contact of the last SW relay. Thus with all SW and SWS relays normal ground is applied to each end of the switch preference chain. This arrangement improves the reliability of the preference chain and also improves the distribution of traffic through the switches.

2.02 When a demand for service within a switch is recognized, the trunk TP relay operates, extending ground from the switch preference chain to the winding of the SW and SWS relays causing them to operate. The SW and SWS relays operated:

- (a) Release the GT relay.
- (b) Open the operate path of SW and SWS relays in lower numbered switches.
- (c) Locks to ground through a make contact of the SW relay.

SW and SWS relays in other switches may operate from ground on the break contact of the last SW relay in the preference chain. Therefore, with at least one SW relay operated and the GT relay released, only higher numbered SW and SWS relays can operate.

2.03 Each crossbar switch has 12 select magnets, one for each converter. A maximum of 7 select magnets of different switches are associated with the same converter. These select magnets are arranged in a preference chain by transfer contacts of the SWS relays. There are 12 separate switch select magnet preference chains, one for each converter, with the select magnets of the first switch being most preferred.

2.04 The SWS relay operates when a demand for service is recognized. The SWS relay operated extends battery to all associated select magnets and opens the operate path of all higher numbered switch select magnets. A switch select magnet operates when the converter allotter seizes an idle converter, as indicated by the operation of the associated CA- and CS- relays. The CA- and CS- relays operated extend ground to the winding of the select magnet causing it to operate. This causes the operation of the hold magnet associated with the trunk that initiated the seizure. When all trunks within a switch that had a demand for service are served, the SWS relay releases, extending battery to the next switch select magnets having a SWS relay operated, allowing that switch to connect to converters and serve subscriber demands for service.

3. Converter Allotter Operation

3.01 When all converter available (CA-) relays are released the reset (RES1 and RES2) relays release. Guarded battery (EPB Lead) is supplied to each end of the odd numbered CA- relay chain by the 11 and 12 break contacts of the RES1 and RES2 relays, while guarded battery (GHB lead) is supplied to each end of the even numbered CA- relay chain by the 9 and 10 break contacts. At this time the CA- relays associated with available converters operate by the ground from the converters MB relay make contact, CA lead from the converter, and break contacts of the CAR- and CS- relays. Each operated CA- relay locks to its own C-battery. When a CA- relay operates a path is provided to operate the RES1 and RES2 relays. Once RES1 and RES2 relays operate the nonoperated odd numbered CA- relays can only operate if a lower numbered odd CA- relay is operated and the nonoperated even numbered CA- relays can only operate if a lower numbered even CA- relay is operated.

3.02 A request for service is received by the converter allotter when the GT relay releases. The released GT connects ground to the CA-/CS- relay chain. This ground will operate the converter seize (CS-) relay associated with the lowest operated CA- relay. The CS- relay operated will seize the associated converter by grounding the "A" lead which in turn operates the converters ON relay. This ground is also used in the select magnet control circuit.

3.03 After the connection of the trunk to converter has been made and verified the gate release (GTR/GTR1) relays operate. These relays release the CA- relay, select magnets, TP- relay, SW-/SWS- relays and GTR/GTR1 in that order leaving the circuit ready to serve the next request for service.

4. Alarm and Release

Work Timer

4.01 One second TM timer, times the progress of the connection of a trunk to a converter, from the seizure of a switch to the operation of the gate release relay GTR. The TM timer is started when the SW relay of one of the switches operates. If the GTR relay operates within 1 second the timer is recycled, if the GTR relay does not operate within 1 second a timeout occurs and the AL1 relay operates. The AL1 relay operated performs the following functions:

- (a) Extends battery to the winding of the Converter Available Release relay CAR-.
- (b) Prepares an operate path for the AL6 relay.
- (c) Causes the AL3 relay to operate.
- (d) Extends a ground to the windings of the SWA- relay causing the SWA- relay associated with the switch that initiated the alarm to operate from resistance battery supplied through a make contact of the lowest numbered operated SW- relay.

The SWA- relay operated performs the following functions:

- (a) Transfers battery of the trunk preference chain to a break contact of the release relay REL.
- (b) Prepares an operate path for the REL relay.
- (c) Extends battery to the winding of the AL relay.
- (d) Extends ground to the winding of the associated SWB- relay causing it to operate.

The SWB- relay operated extends ground to the winding of the AL2 relay causing it to operate and lock to ground on the "AR1" lead of the Miscellaneous Circuit through one of its make contacts. The AL2 relay operated applies ground to the "MN" lead of the Miscellaneous Circuit, operating the MN relay. When this relay operates the MN Light Emitting Diode (LED) is lighted and a minor alarm is sounded. Also with the SWB relay operated the lamp latching circuit sends the trunk number and switch number to the Miscellaneous Circuit for trouble recording purposes. The AL2 relay applies ground through the operated

CAR relay to operate the associated converter or latching relay CL-. The operated CL- relay locks up through its own make contact to the "AR1" lead and sends the converter number to the Miscellaneous Circuit for trouble recording purposes. The SWA- and AL2 relays operated, operates the release relay REL. The REL relay operated, locks to ground through its own make contact and a make contact of the AL1 relay. Also with the REL relay operated the following functions are performed:

- (a) Battery is removed from the Trunk Preference Chain of the switch that initiated the timeout. This causes the TP- relays that were locked operated to release, releasing the associated SW- relay.
- (b) Removes ground from the Converter Allotter Circuit causing it to advance to the next available converter.
- (c) Opens the hold path of the SWA- relay causing it to release. The SWA- relay released, releases the SWB- relay and reapplies battery to the Trunk Preference Chain allowing the switch to again serve subscriber demands for service.
- (d) Removes battery from the TM timer causing the AL1 relay to release, which in turn releases the REL relay. The REL relay released reapplies battery to the AL relay and the TM timer, allowing the timer to time other seizures. Also with the REL relay released ground is reapplied to the converter allotter circuit allowing the next available converter to be seized.

Therefore, when the TM timer times out the following is accomplished:

- (a) The "MN" LED is lighted and a minor alarm is sounded.
- (b) All the trunks within the switch, that caused the timeout, are released.
- (c) The converter allotter is advanced to the next available converter.
- (d) Once the SWA- relay is released the switch is allowed to serve calls again.
- (e) For trouble recording purposes the Converter Trunk and Link is connected to the Miscellaneous Circuit.

The minor alarm may be retired by operating the AR key in the Miscellaneous Circuit.

RES1 and 2 Check

4.02 An alarm relay AL is provided to check that the converter allotter reset relays RES1 and RES2 operate simultaneously. The AL relay is a slow release, normally operated relay which is initially operated from a ground provided by the alarm release relay AR1 in the Miscellaneous Circuit. The AL relay once operated locks to resistive ground through one of its own make contacts and the transfer contacts of the RES1 and RES2 relays, which are connected in such a way as to provide a hold path if they operate and release simultaneously. If either RES1 or RES2 should not operate, the AL relay will release because its hold path will be opened. The AL relay released applies ground to the Miscellaneous Circuit "RF" lead causing the redundancy failure "RF" LED to light. Also ground is applied to the Miscellaneous Circuit "MJ" lead which results in a major alarm "MJ" LED being lighted and major alarm being sounded. The major alarm is extinguished by operating the AR key in the Miscellaneous Circuit.

Two Timeout Alarm

4.03 When an initial timeout occurs, the AL3 relay operates through its own break contact and immediately transfers through the make-before-break spring arrangement to a direct locking ground. At this time the AL4 relay is prevented from operating by the ground applied through its break contact as a shunt. When the TM timer is recycled, the AL1 relay releases, operating the AL5 relay. The AL5 relay once operated, locks to ground through a make contact of AL3 and prepares an operate path for the AL6 relay. The ground is removed from the shunt around the AL4 relay when the GT relay operates. The GT relay operates when all SW- relays are released. This indicates all calls have been served and no demands for service exist at this time. Upon the recognition of a demand for service a SW- relay will operate, releasing the GT relay. With the GT relay released a ground is extended through a make contact of the AL4 relay, shunting the AL3 relay. The AL3 relay released, transfers the holding path for the AL4 and AL5 relays to the "AR1" lead through a break contact of the GT relay. When the GT relay operates again, due to all calls being served, the hold path for the AL4 and AL5 relays is opened, causing them to release.

4.04 If a second timeout occurs, causing the operation of the AL1 relay, before the minor alarm of the first timeout is retired or the AL5 relay is released, the AL6 relay will operate. The AL6 relay is operated from ground extended through make contacts of the AL1 and AL5 relays and locks to

ground in the Miscellaneous Circuit through its own make contact. With the AL6 relay operated, ground will be extended to the Miscellaneous Circuit over the "2TO" and "MJ" leads lighting the two timeout "2TO" LED in the Miscellaneous Circuit and causing a major alarm to be sounded. This alarm is retired by the operation of the AR key in the Miscellaneous Circuit.

5. Lamp Latching Circuit

5.01 When a timeout occurs particular Light Emitting Diodes (LED) TO-19, SO-6 and CO-11 in the Miscellaneous Circuit are lighted for trouble recording purposes. These LED's represent the particular trunk, switch and converter involved when a timeout occurs. The LED's are lighted from ground applied by the trunk TO-19, switch SO-6, and converter latch CLO-11 lamp latching relays. When a timeout occurs the lamp latching relays T- and S- are operated from ground applied through the make contacts of the operated SWB- relay associated with the switch in which the timeout occurred. The converter alarm display latching relay CL- operates from ground applied through the make contact of the operated converter available release relay CAR- associated with a particular converter. The lamp latching relays once operated lock to the alarm release lead "AR". The LED display is extinguished by operating the AR key in the Miscellaneous Circuit.

SECTION III - REFERENCE DATA

1. Working Limits

None

2. Function Designations

2.01 Relays

<u>Designation</u>	<u>Meaning</u>
AL	Alarm Guard of RES1/RES2 Relays
ALL-6	Alarm Display and Release
CA-	Converter Available
CAR-	Converter Available Release
CL-	Converter Alarm Display Latch
CS-	Converter Sieze
GT	Switch Gating
GTR	Gating Release

<u>Designation</u>	<u>Meaning</u>
GTR1	Gating Release (back up)
REL	Release Alarm
RES1/RES2	Converter Allotter Reset
SO-6	Switch Alarm Display Latch
SW-	Switch Preference
SWA-	Switch Preference Alarm
SWB-	Switch Trunk Buffer Connector
SWS-	Switch Preference Supplementary
TO-19	Trunk Alarm Display Latch
TBO-19	Trunk Busy
TPO-19	Trunk Preference
TSO-19	Trunk Siezed

3. Functions

- 3.01 Recognizes seizure when a line finder extends ground to the sleeve.
- 3.02 Recognizes simultaneous demands for service in any switch.
- 3.03 Serves one demand at a time beginning with the demand in the lowest numbered trunk in the lowest numbered switch and proceeding to all demands in that switch.
- 3.04 Recognizes the first or simultaneous demands in higher numbered switches while serving demands in a lower numbered switches.
- 3.05 Will not recognize new demands or serve demands for service in lower numbered switches until all recognized demands have been served in higher numbered switches.
- 3.06 Recognizes idle converters as being available to serve demands for service.
- 3.07 Allots recognized available converters one at a time to serve demands, beginning with the lowest numbered converter which is recognized.
- 3.08 Allots all recognized converters before recycling to recognize newly idled converters with lower numbers.
- 3.09 Operates the select magnet which has the same number as the allotted converter and in the switch being served.
- 3.10 Operates the hold magnet associated with trunk being served.

- 3.11 Recognizes link closure and converter ready by operation of the trunk seize relay TS-.
- 3.12 Marks a trunk busy by operating the TB- relay to the grounded sleeve.
- 3.13 Recognizes converter connection by releasing trunk preference (TP-) and converter available (CA-) relays.
- 3.14 Starts trouble timing when a demand is recognized in a switch, and at least one converter is recognized as being available.
- 3.15 Stops trouble timing when a converter connection is recognized.
- 3.16 Brings in a lamp display to aid in locating troubles when a timeout occurs.
- 3.17 Releases all recognized demands, in a switch that times out, for retrial.
- 3.18 Allots the next recognized available converter for the retrial after a timeout.

4. Connecting Circuits

- 4.01 When this circuit is listed on a key sheet, the information thereon is to be followed.
 - (a) Selector Circuit - SD-30200-01 (typical)
 - (b) Line Switch Circuit - SD-31564-01 (typical)
 - (c) Line Finder Circuit - SD-33013-01 (typical)
 - (d) Two Party Message Rate Trunk Circuit - SD-31506-01

- (e) Trunk Circuit Coin - SD-31592-01 (typical)
- (f) Auxiliary Trunk Circuit Coin - SD-32538-01 (typical)
- (g) Converter Circuit - SD-35032-01
- (h) Test Circuit - SD-35034-01
- (i) Miscellaneous Circuit - SD-35035-01
- (j) Coin Trunk Circuit - SD-32539-01

5. Manufacturing Testing Requirements

- 5.01 The register link shall be capable of performing all of the service functions specified in the circuit description and meeting all the requirements of the circuit requirements table.

6. Alarm Information

- 6.01 When a trouble timeout occurs, the minor audible alarm will be sounded and an appropriate aisle pilot lamp lighted. The particular trunk, switch and converter which was in the process of being served will be indicated by steadily lighted LED's on the Miscellaneous Circuit. If a second timeout should occur shortly after the first, but before the first is retired, a major audible alarm will be sounded and the appropriate aisle pilot lamp lighted. The 2TO LED will be lighted on the Miscellaneous Circuit. Operation of the alarm release key AR will silence the alarm and extinguish the lamp display. Operation of a 48 volt fuse will light the fuse alarm lamp and sound an audible alarm. The lamp and alarm will be retired when the blown fuse is removed.

BELL TELEPHONE LABORATORIES, INCORPORATED

DEPT. 5245 - LCB
WECO DEPT. 5151-SAM-WEA