PG-FLEX

TECHNICAL PRACTICE

8 CHANNEL
LOOP START/GROUND START POTS
REMOTE TERMINAL CHANNEL UNIT

Model	List	CLEI Code
FRC-754	4B	N/A

Revision History of This Practice

Revision	Release Date	Revisions Made
01	October 22, 1999	Initial Release
02	January 10, 2002	Release to rebrand document to comply with ADC standards
03	January 6, 2003	Updated Product Support Information

USING THIS PRACTICE

Three types of messages, identified by icons, appear in the text.

Notes indicate information about special circumstances.

Cautions indicate the possibility of equipment damage or the possibility of personal injury.

Electrostatic Discharge (ESD) susceptibility symbols indicate that a device or assembly is susceptible to damage from electrostatic discharge.You must wear an antistatic wrist strap connected to the appropriate ground connection prior to performing installation procedures. You must also observe normal ESD precautions when handling electronic equipment. Do not hold electronic plugs by their edges. Do not touch components or circuitry.

INSPECTING YOUR SHIPMENT

Upon receipt of the equipment:

- Unpack each container and visually inspect the contents for signs of damage. If the equipment has been damaged in transit, immediately report the extent of damage to the transportation company and to ADC. Order replacement equipment, if necessary.
- Check the packing list to ensure complete and accurate shipment of each listed item. If the shipment is short or irregular, contact ADC as described in "Returns" on page 10. If you must store the equipment for a prolonged period, store the equipment in its original container.

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OVERVIEW

The ADC® PG-Flex® FRC-754 Channel Unit provides eight loop start or ground start POTS interfaces between a PG-Flex RT and subscribers. The FRC-754 uses A-Law pulse code modulation (PCM) encoding. For subscriber circuit testing, the FRC-754 provides metallic access to the subscriber line connection through an optional metallic bypass pair.

DESCRIPTION

Features of the PG-Flex FRC-754 CU are:

- eight loop start or ground start POTS subscriber interfaces
- 64 kbps A-Law PCM encoding
- meter tones (12 kHz, 16 kHz)
- front panel ACTIVE LEDs indicate on-hook (idle), ringing, metallic access, and off-hook condition for each channel
- front panel FAULT LED indicator simplifies troubleshooting
- Pair Gain Test Controller (PGTC) compatibility
- Custom Local Area Signaling Services (CLASS) support (such as, caller ID)
- line-side answer supervision support (reverse battery)
- forward disconnect
- distinctive ringing
- application of ringing voltage
- detection of loop off-hook, ground start seizure, and Ring-Trip conditions

FRONT PANEL

The FRC-754 front panel (Figure 1) includes green status LEDs for each line indicating on-hook (idle), ringing, and off-hook conditions, as well as a red LED indicating a fault condition on the CU. Table 1 lists the FRC-754 List 1A front panel LED states and functions, and describes the labels.

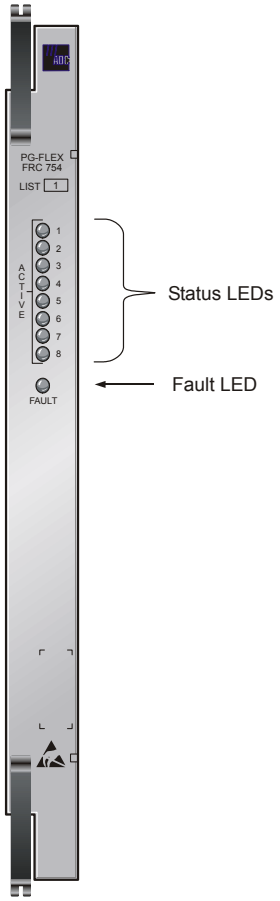

Figure 1. *FRC-754 List 1A Front Panel*

Table 1. *FRC-754 Front Panel LEDs and Labels*

LED and Labels	Function
ACTIVE (1 through 8)	Solid green: Channel is off hook. Fast flashing green: Channel is in test access mode. Slow flashing green: LED follows the ring signal. Off: Channel is on hook (idle).
FAULT	Red: Fault detected by the unit. See Table 10 on page 9 for troubleshooting procedures. Off: No faults detected.
Warranty Control Number Label	Indicates the beginning year and month of the equipment warranty. Also indicates the unit revision number. For example, a warranty control number of 71203 indicates a warranty beginning 1997 (7), in December (12), and the revision is 03.
Bar Code Label	Contains the serial number and part number of the equipment in both bar code and text formats.

SPECIFICATIONS

Electrical Characteristics

Analog Impedance	600 Ω
Subscriber Drop	960 Ω (including 430 Ω for the handset)
DC Loop Current	≥ 23 mA
Ringer Output	40 V RMS, 3 lines simultaneously, 5 REN each
End-to-End Loss	-2.5 dB ± 1.0 dB at 1004 Hz
Lightning Protection	Meets all requirements (GR-CORE-1089, Section 4)

Environmental

Operating Elevation	–200 ft. to 13,000 ft. (–60 m to 4000 m)
Temperature	–40° F to +150° F (–40° C to +65° C)
Humidity	5% to 95% (non condensing)

Physical

Weight	0.6 lb. (0.3 kg.)
Height	12.0 in. (30.5 cm.)
Width	1.0 in. (2.5 cm.)
Depth	4.5 in. (11.4 cm.)

OPERATIONAL CAPABILITIES

The FRC-754 CU provides eight loop start or ground start POTS interfaces between the RT and subscribers, and performs the following functions:

- 64 kbps A-Law PCM encoding
- applies ringing voltage
- generates forward disconnect
- generates 12 kHz or 16 kHz meter tones
- detects an off-hook or ring-trip condition
- connects a subscriber loop to a metallic bypass pair
- protects against secondary surges

The subscriber line battery is supplied by a constant current supply. It is sufficient to operate a telephone set over the indicated loop length. The battery feed can be disconnected and the loop opened to release subscriber equipment when a forward disconnect signal is received from the FLC-704 COT line unit. The battery feed polarity can also be reversed as a physical signal of far end supervision.

CIRCUIT OPERATION

The following paragraphs define the FRC-754 circuit operation when using loop start for subscriber lines or ground start for PBX lines. Each FRC-754 circuit has an associated LED that indicates when the line is off-hook, idle, ringing, or under test (see Table 1 on page 2).

Loop Start Operation

The following section summarizes the loop start sequences for on-hook (idle), subscriber inititated outgoing calls, subscriber received incoming calls, and busy conditions.

On-hook (Idle) Condition

Loop start idle condition is a Ring-lead negative and Tip-lead positive from the CO with the same condition out of the RT toward the subscriber (see Table 2 for circuit interactions).

Table 2. *Circuit Interactions for an Idle Condition (Loop Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
Circuit Idle	No ringing ⇐	⇒ On-hook	No ringing ⇐	⇒ On-hook

Subscriber Initiated Outgoing Call

The following occurs when the calling line goes off-hook (see Table 2 on page 4 for circuit interactions):

- loop current flows and is detected by the FRC-754 CU
- FLC-704 receives an off-hook signal from the RT
- FLC-704 generates an off-hook condition to the CO switch
- CO sends dial tone
- FRC-754 passes a dial pulse or Dual Tone Multi Frequency (DTMF) signal through the FLC-704 from the subscriber and forwards these to the CO

Table 3. *Circuit Interactions When a Subscriber Initiates an Outgoing Call (Loop Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
CO Idle	No ringing	⇒	No ringing	⇒
Subscriber goes off-hook	⇐	Off-hook	⇐	Off-hook
CO returns dialtone	Dialtone	⇒	Dialtone	⇒
Subscriber Dials	⇐	DP or DTMF	⇐	DP or DTMF

Subscriber Receives Incoming Call

The following occurs for an incoming call (see Table 4 for circuit interactions):

- FLC-704 detects a ringing signal from the CO
- FLC-704 signals the FRC-754 which then connects ringing to the subscriber
- subscriber line goes off-hook and the FRC-754, through the FLC-704, provides an off-hook condition to the CO switch

Table 4. *Circuit Interactions When a Subscriber Receives an Incoming Call (Loop Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
Subscriber Idle	⇐	On-hook	⇐	On-hook
CO generates ringing	Ringing	⇒	Ringing	⇒
Subscriber goes off-hook	⇐	Off-hook	⇐	Off-hook
Ring trip	No ringing	⇒	No ringing	⇒

Busy Condition

The loop start busy condition at the RT is a Ring lead negative and a Tip lead positive with loop current flowing. The same conditions occur at the CO (see Table 5 for circuit interactions).

Table 5. *Circuit Interactions for a Busy Condition (Loop Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
Circuit busy	No ringing	⇒	No ringing	⇒
	⇐	Off-hook	⇐	Off-hook

Ground Start Operation

The following section summarizes the ground start sequences for on-hook (idle), subscriber inititated outgoing calls, subscriber received incoming calls, and busy conditions.

Idle Condition

The ground start idle condition is a Tip-lead open and Ring-lead negative from the CO and Tip lead open and Ring-lead negative at the RT (see Table 6 for circuit interactions).

Table 6. *Circuit Interactions for an Idle Condition (Ground Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
Circuit Idle	Tip - no ground No ringing	⇒	Tip - no ground No ringing	⇒

Table 6. *Circuit Interactions for an Idle Condition (Ground Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
	⇐	Ring - no ground On-hook	⇐	Ring - no ground On-hook

Subscriber Initiates Outgoing Call

The following occurs when a PBX requests service for an outgoing call (see Table 7 for circuit interactions):

- PBX grounds Ring lead at the RT
- FRC-754 signals the FLC-704
- FLC-704 operates a Ring-ground relay that requests dial tone from the CO (this makes the circuit busy, or seizes it, for outgoing calls, and blocks any incoming calls prior to the PBX dialing (that is, it prevents glare where incoming and outgoing calls may occur simultaneously on the same line). Glare occurs when both ends of a telephone line or trunk are seized at the same time.
- CO sends dial tone and grounds the Tip to signal the PBX to begin dialing
- FLC-704 detects Tip-ground, closes the loop between Tip and Ring, and signals the FRC-754 to send Tip ground to the PBX
- PBX removes the original Ring-ground condition and completes the loop (Tip and Ring)

Table 7. *Circuit Conditions When a Subscriber Initiates an Outgoing Call (Ground Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
CO Idle	Tip - No ground No ringing	⇒	Tip - No ground No ringing	⇒
Subscriber requests dialtone	⇐	Ring - ground On-hook	⇐	Ring - ground On-hook
CO returns dialtone	Tip - ground Dialtone	⇒	Tip - ground Dialtone	⇒
Subscriber Dials	⇐	Ring - no ground Off-hook DP or DTMF	⇐	Ring - no ground Off-hook DP or DTMF

Subscriber Receives Incoming Call

The following occurs for an incoming call (see Table 8 for circuit interactions):

- FLC-704 detects a ringing signal from the CO, along with Tip-ground
- FLC-704 signal the FRC-754 to connect Tip-ground and ringing to the PBX
- PBX goes off-hook and the FRC-754, through the FLC-704 closes the loop between Tip and Ring, the CO disconnects ringing and establishes an audio path

Table 8. *Circuit Conditions When a Subscriber Receives an Incoming Call (Ground Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
Subscriber Idle	⇐	Ring - no ground On-hook	⇐	Ring - no ground On-hook
CO seizes loop	Tip - ground No Ringing	⇒	Tip - ground No Ringing	⇒
CO generates ringing	Tip -ground Ringing	⇒	Tip -ground Ringing	⇒
Subscriber goes off-hook	⇐	Ring - no ground Off-hook	⇐	Ring - no ground Off-hook
Ring trip	Tip - ground No ringing	⇒	Tip - ground No ringing	⇒

Busy Condition

The ground start busy condition at the RT is a Ring lead negative and a Tip lead positive with loop current flowing. The same conditions occur at the CO (see Table 9 for circuit interactions).

Table 9. *Circuit Conditions for a Busy Condition (Ground Start)*

Operation	CO Switch	FLC-704 COCU	FRC-754 RTCU	Subscriber
Circuit busy	Tip - ground No ringing	⇒	Tip - ground No ringing	⇒
	⇐	Ring - no ground Off-hook	⇐	Ring - no ground Off-hook

CLASS Features

PG-Flex supports on-hook transmission of analog signals. When Call ID (a CLASS feature) is activated, the CO generates analog signalling toward the PBX between the first and second bursts of the ringing signal.

Forward Disconnect

The forward-disconnect function releases a called line that was left on hold or an answering set that requires a loop open to be able to turn off.

INSTALLATION AND TEST

INSTALLING

Observe normal electrostatic discharge precautions when handling electronic equipment. Do not hold electronic plugs by their connector edges. Do not touch components or circuitry.

1 Insert each FRC-754 into the RT enclosure, then see if all LEDs on the CU:

- turn ON for approximately 2 seconds
- scan from top to bottom
- flash all ON, then OFF

If the LEDs do not follow the above sequence, see Table 10 on page 9.

2 After the system has powered up, established HDSL synchronized communications, and no calls are in progress, verify that the CU front panel indicators ACTIVE 1 through ACTIVE 8 and FAULT LEDs are all off.

To activate the ground start feature, use a List 3 of higher PG-Flex CO and RTLUs.

To reduce power at the RT, the FRC-754 LEDs turn off after a two minute time-out period. Press and hold the ACO button on the RT line unit for two seconds to turn on the LEDs for another two minutes.

PROVISIONING

Provision the FRC-754 using the appropriate line unit technical practice. For each channel provisioned, select the loop start of ground start option.

VERIFY INSTALLATION

After the PG-Flex system is powered up and HDSL communication is synchronized:

1 Verify that the front panel ACTIVE indicators are all OFF and the FAULT indicator is OFF (no calls are in progress).

2 Test the loop start circuits, as follows:

- Place an outgoing call for each subscriber circuit provisioned, and verify that the ACTIVE LED tracks the progress of the call (refer to Table 1 on page 2 for front panel indications)
- Place an incoming call to each subscriber circuit provisioned, and verify that the ACTIVE LED tracks the progress of the call (refer to Table 1 on page 2 for front panel indications)

3 Test the ground start circuits, as follows:

- Place an outgoing call for each subscriber circuit provisioned, and verify that the ACTIVE LED tracks the progress of the call (refer to Table 1 on page 2 for front panel indications)
- Place an incoming call to each subscriber circuit provisioned, and verify that the ACTIVE LED tracks the progress of the call (refer to Table 1 on page 2 for front panel indications)

TROUBLESHOOTING

Table 10. *FRC-754 CU Troubleshooting Procedures*

Indication	Problem	Action
FAULT LED On	The FRC-754 processor has detected a fault.	Remove and reinsert the CU. If the FAULT LED does not extinguish, replace the CU.
Troubleshooting based on customer-originated trouble reports		
No Dial Tone, Can not Dial	• faulty RT or COT CU • facility short/open • CO switch problem • Tip/Ring reversed at CO	**1** Lift the subscriber pair at the network interface. If a dial tone is present and you can place a call, refer the problem to the customer per local practice. **2** If you can not hear a dial tone or can not place a call at the network interface (with the subscriber pair lifted), check for a dial tone at the RT. If a dial tone is present, check the pair between the RT and the network interface. If no dial tone is present, replace the RT CU. **3** If the problem still exists, reinsert the original RT CU and replace the COT CU. Test for operation. **4** If the problem still exists, refer the problem to the CO switch.
Phone Does not Ring	• high-resistance subscriber line short • faulty RT or CO CU • loop length too long	**1** Lift the subscriber pair at the network interface. If ringing is present, refer the problem to the customer per local practice. **2** If ringing is not present, check for ringing at the RT. If ringing is present, check the pair between the RT and the network interface. If no ringing is present, replace the RT CU. If ringing is still not present, check a circuit on another CU. If ringing is still not present, replace the RT Line Unit. **3** If ringing is still not present at the RT, reinsert the original CU and Line Unit. Test for ringing at the COT. **4** Test for ringing into the COT from the CO switch. If no ringing is present, refer the trouble to the CO switch. If ringing is present, replace the COT CU. Test again for ringing at the network interface. If ringing is still not present, contact ADC technical assistance per Product Support on inside back cover. **5** Verify the resistance of the copper loop between the RT Enclosure and the network interface is less than 530 Ω.
Phone Does not Stop Ringing	• faulty subscriber instrument • faulty RT CU • loop length too long	**1** Test for ring trip at the network interface. If the ringing is tripped, refer the trouble to the customer per local practice. **2** If the ringing is not tripped, test for tripping at the RT. If ring trip does occur, check the loop for excessive length. If ring trip does not occur, replace the RT CU. If ring trip still does not occur, contact ADC technical assistancProduct Support on inside back cover. **3** Verify the resistance of the copper loop between the RT Enclosure and the network interface is less than 530 Ω.
Can not Hear, Can not Be Heard	• subscriber problem • faulty RT or COT CU	**1** Lift the subscriber line at the network interface and check the signal level. If correct, refer trouble to the customer per local practice. **2** If the level is too low, check the level at the RT. If the level is correct at the RT, check the pair between the RT and the network interface. If the level is too low at the RT, replace the RT CU. **3** If the level is still too low, reinsert the original RT CU. **4** Check the level at the COT coming from the CO switch. If it is correct, replace the COT CU. If it is not correct, refer the problem to the CO regarding the switch. **5** If the level is still not correct, reinsert the original COT CU. Contact ADC technical assistance per Product Support on inside back cover.

PRODUCT SUPPORT

TECHNICAL SUPPORT

Technical Assistance is available 24 hours a day, 7 days a week by the contacting Customer Service Engineering group at:

Telephone:	800.366.3891 The 800 telephone support line is toll-free in the U.S. and Canada.
Email:	wsd_support@adc.com
Knowledge Base:	http://adc.com/Knowledge_Base/index.jsp
Web:	www.adc.com

LIMITED WARRANTY

Product warranty is determined by your service agreement. Refer to the ADC Warranty/Software Handbook for additional information, or contact your sales representative or Customer Service for details.

RETURNS

To return equipment to ADC:

1 Locate the number of the purchase order under which the equipment was purchased. To obtain a return authorization number, you need to provide the original purchase order number to ADC's Return Material Authorization (RMA) Department.

2 Call or write ADC's RMA Department to ask for an RMA number and any additional instructions. Use the telephone number, fax number or email address listed below:

- Telephone: 800.366.3891
- Email Address: rma@ADC.com

3 Include the following information, in writing, along with the equipment you are returning:

- Company name and address.
- Contact name and telephone number.
- The shipping address to which ADC should return the repaired equipment.
- The original purchase order number.
- A description of the equipment that includes the model and part number of each unit being returned, as well as the number of units that you are returning.
- The reason for the return. For example:
  - The equipment needs an ECO/ECN upgrade.
  - The equipment is defective.

If the equipment is defective, please tell us what you observed just before the equipment malfunctioned. Be as detailed in your description as possible.

If there is another reason for returning the equipment, please let us know so we can determine how best to help you.

4 Pack the equipment in a shipping carton.

5 Write ADC's address and the RMA Number you received from the RMA Department clearly on the outside of the carton and return to:

ADC DSL Systems, Inc.
14352 Franklin Ave.
Tustin, CA 92780-7013

Attention: **RMA (Number)**

All shipments are to be returned prepaid. ADC will not accept any collect shipments.

FCC CLASS A COMPLIANCE

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the use will be required to correct the interference at his own expense.

Modifications

The FCC requires the user to be notified that any changes or modifications made to this device that are not expressly approved by ADC Technologies, Inc. voids the user's warranty.

All wiring external to the product(s) should follow the provisions of the current edition of the National Electrical Code.

ACRONYMS

2B1Q	2 binary bits encoded in one quaternary symbol
AWG	American Wire Gauge
CLASS	Custom Local Area Signaling Services
CO	Central Office
COT	Central Office Terminal
DS0	Digital Signal Level Zero
DTMF	Dual Tone Multi-Frequency
HDSL	High-bit-rate Digital Subscriber Line
MLT	Mechanized Loop Testing
PBX	Private Branch Exchange
PCM	Pulse Code Modulation
PGTC	Pair Gain Test Controller
POTS	Plain Old Telephone Service
RMA	Return Material Authorization
RT	Remote Terminal
RTLU	Remote Terminal Line Unit

World Headquarters:
ADC Telecommunications, Inc.
12501 Whitewater Drive
Minnetonka, Minnesota USA 55343

For Technical Assistance:
800.366.3891

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