

TCDPG/DSC Installation, Maintenance, and Loop Prequalification Guidelines

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1. General

- 1.1 Purpose** This practice provides information designed to aid Outside Plant (OSP) engineers with the design and installation of a Two-Channel Digital Pair Gain (TCDPG)/Digital Subscriber Carrier (DSC). This practice provides the linkages between different departments for establishing TCDPG/DSC in the exchange area.
- 1.2 Filing Instructions and Supersedures** Discard all previous issues and associated addenda of this practice and file this issue numerically in your GTE Telephone Operations practices set.
- This practice supersedes and cancels:
- All policies, procedures, general instructions, letters, and memoranda which address this subject.
 - Any document which provides information contrary to the information contained in this practice.
- 1.3 Reason for Reissuing** This practice has been reissued to reflect deployment guidelines for analog carriers with no distinction made between single or multichannel.
- Read this entire practice to ensure your familiarity with the new information.
- 1.4 Responsibility** This practice was published by the GTE Telephone Operations Administrative Services Department. For more information about this practice, contact the Headquarters Network Provisioning -Outside Plant Engineering Department.
- 1.5 Disclaimer** This practice was prepared solely for the use of GTE Telephone Operations. It must be used only by its employees, contractors, customers, and end users when installing, operating, maintaining, and repairing GTE Telephone Operations' equipment, facilities and services. Any other use of this practice is forbidden. The information contained in this practice may not be applicable in all circumstances and is subject to change without notice. By using this practice the user agrees that GTE Telephone Operations will have no liability (to the extent permitted by applicable law) for any consequential, incidental, special, or punitive damages that may result.

2 Overview

- 2.1 Introduction** The TCDPG/DSC is a digital pair gain device that provides two Plain Old Telephone Service (POTS) lines over a nonloaded, unconditioned cable pair. The TCDPG/DSC supports Custom Local Area Signaling Service (CLASS) services, facsimile, and data up to 9.6 Kb/s for a distance less than or equal to 1300 ohms or 42 dB loss at 40 kHz.
- The TCDPG/DSC lets GTE minimize and/or avoid the deployment of additional copper distribution plant:
- In areas of slow growth.
 - Where GTE is trying to extend the life of the existing copper plant pending introduction of fiber distribution facilities.
- Widespread deployment of TCDPG/DSC across all GTE markets is not anticipated. The primary applications for this technology are expected in urban and/or suburban markets.

2. Overview, continued

2.2 Definitions

The following chart provides definitions for the acronyms used in this practice.

Acronym	Definition
ACO	Alarm Cut-Off
AML	Added Main Line
CLASS	Custom Local Area Signaling Service
CO	Central Office
COE	Central Office Equipment
COEC	Central Office Equipment Construction
COT	Central Office Terminal
DSC	Digital Subscriber Carrier
DSL	Digital Subscriber Line
FAC	Facility Administration Center
HDSL	High bit rate Digital Subscriber Line
ICGS	Interactive Computer Graphics System
I&M	Installation and Maintenance
ISDN-BRI	Integrated Service Digital Network-Basic Rate Interface
LED	Light Emitting Diode
LIF	Left In Facility
MARK	Mechanized Assignment Record Keeping
NID	Network Interface Device
OSP	Outside Plant
POTS	Plain Old Telephone Service
RFF	Reserved Future Funds
RT	Remote Terminal
SDC	Subscriber Digital Carrier

(continued)

2. Overview, continued

2.2 Definitions, continued

Acronym	Definition
SNI	Standard Network Interface
SPAU	Shelf Power/Alarm Unit
TCDPG	Two-Channel Digital Pair Gain

2.3 References

For additional information related to this practice, see GTE Telephone Operations Practice 938-01 O-001 , Customer Service Delayed Order Procedure.

2.4 Technical Description

The basic architecture of the TCDPG/DSC system consists of a:

- Central Office Terminal (COT).
- Remote Terminal (RT).
- Digital Subscriber Line (DSL).

The basic system is line-powered from the Central Office (CO), thus eliminating the need for batteries at the RT. The TCDPG/DSC architecture permits the addition of a second telephone line without having to use another cable pair.

The second line will either be:

- Derived by the system and used to provide additional service to an existing customer.
- OR
- Used to provide service to a new customer.

Unlike analog Added Main Line (AML) and 84A-type carriers, where the carrier is added to the cable pair and a carrier derived pair is used for the second line service, the TCDPG/DSC uses one cable pair to electronically derive single lines. A diagram of typical TCDPG/DSC design configurations is shown in Section 2.5.

The technology that provides the two POTS lines over a single cable pair also provides Integrated Service Digital Network-Basic Rate Interface (ISDN-BRI). The TCDPG/DSC provides:

- Two 64 Kb/s B channels.
- One 16 Kb/s D channel.

NOTE: This combination of channels is known as 2B+ D.

The two B channels provide digital voice circuits; the D channel is available for other services (e.g., data and other future services depending on market direction).

The TCDPG/DSC uses the 2B1 Q transmission scheme. This scheme provides 160 Kb/s over a loop with some bridge tap up to 42 dB of loss without any regeneration. The line code works in combination with an echo cancellation hybrid network that allows transmission in a full-duplex mode.

2. Overview, continued

2.4 Technical Description, continued

The TCDPG/DSC with the 2B1Q transmission scheme is expected to let GTE more fully exploit the bandwidth capabilities of the existing copper facilities. This scheme provides the following advantages:

- Digital devices can be run on undesigned pairs.
- Loops do not need to have bridge taps removed unless greater than 2500 feet. No bridge tap length can exceed 2000 feet, regardless of cable gauge.
- Pairs do not have to be conditioned (except for loop prequalification criteria discussed in Section 4.3).

The advantages noted above should result in reduced installation costs and faster service provisioning. Also, the TCDPG/DSC technology will let GTE penetrate deeper into certain market segments with digital services with minimal or no additional costs for new copper OSP facilities.

NOTE: The TCDPG/DSC has the same network deployment issues as basic rate ISDN, i.e., frequency spectrum interference with analog subscriber carrier systems.

Analog carrier systems might experience high levels of noise and become unable to provide quality service to subscribers working on the analog subscriber carrier. Therefore, as a first priority, TCDPG/DSC should not be installed in the same cable sheath with an analog subscriber carrier. (See Section 4.1 for hierarchy.)

ECI Telecom and Wescom® are the standard vendors for TCDPG/DSC devices. Both vendors have adapted their equipment for compatibility with 4TEL Release 28, in accordance with the 4TEL Interface Specifications to UDC Document EOO-621-00 Issue II, which includes both CO bypass and resistance signatures.

Wescom is a registered trademark of Charles Industries Ltd.

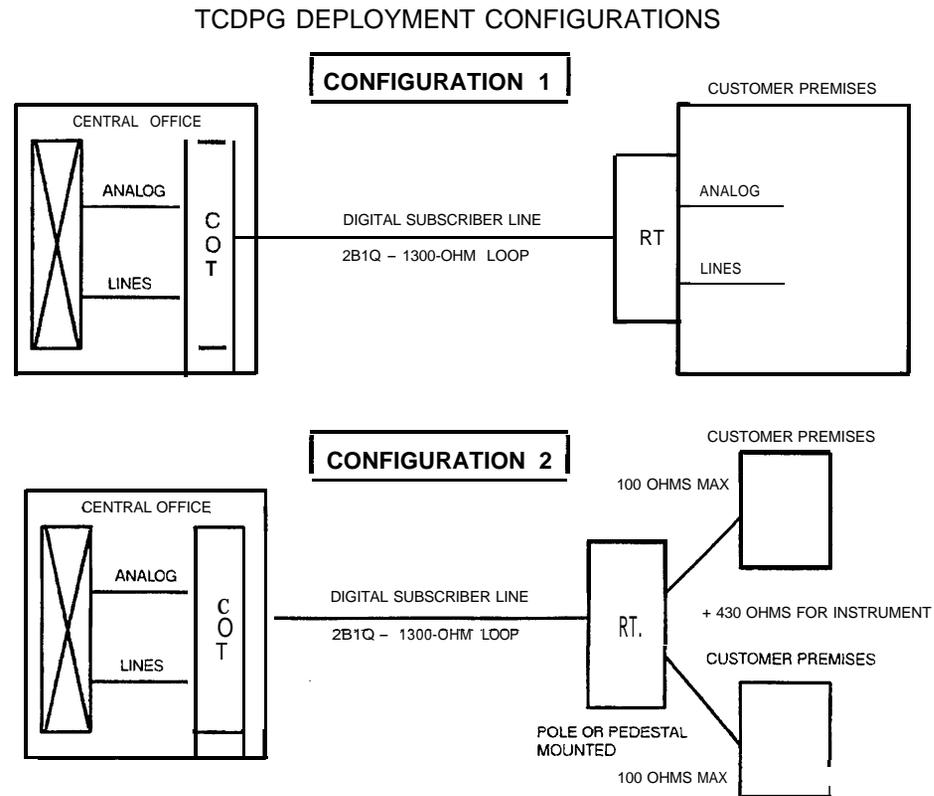
2. Overview, continued

2.5 Configurations

There are two basic configurations for the TCDPG/DSC system:

- Placed at the customer premises.
OR
- Mounted on a pole or pedestal.

Two deployment configurations for the TCDPG/DSC system are shown in the following illustrations.



The deployment of the TCDPG/DSC systems is designed to operate over two-wire, twisted-pair cables. The cable requirements are:

- Loading: Nonloaded.
- Bridge taps: Up to 2500 feet (see Section 2.4).
- Loop impedance: 1300 ohms.

2.6 Service Capabilities

A TCDPG/DSC can provide the following services and capabilities over a single copper pair:

- Two 20 Hz R-I/B-I voice circuits.
- CLASS.
- Facsimile.
- Data up to 9.6 Kb/s.

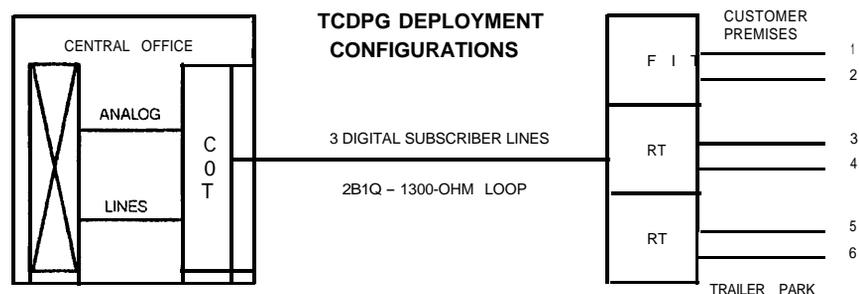
2. Overview, continued

2.7 Applications

The primary purpose of TCDPG/DSC is to reduce and/or eliminate new copper deployment and use the capacity of the existing copper network until fiber optics in the distribution network become more cost-effective.

TCDPG/DSC should be deployed in the following applications subject to the loop prequalifications criteria in Section 4.3:

- Where existing capacity has been exhausted or is in jeopardy (feeder or distribution).
- Second line growth at an existing residence or new single-party service to a new residence over a single copper wire.
- Relief of held orders (Primary/Regrade). TCDPG/DSC can be used to gain an additional pair to satisfy a held order.
- A number of TCDPG/DSC RTs can be mounted in a pedestal to provide initial service to trailer parks or other multitenant locations. ECI and Wescom RTs should mount easily within all standard pedestals that have bonding plates that exceed 8 inches in diameter. ECI uses one type of RT for all applications. Wescom has specific RTs for each application. (See Section 3 for ordering information.) The following illustration shows the pedestal configuration.



- Direct replacement of some analog subscriber carrier systems. Due to the incompatibility of the TCDPG/DSC system and the analog subscriber carrier in the same cable, this application requires the following:
 - Identify a particular route or route segment for analog subscriber carrier removal.
 - Develop a cut-over plan to minimize possible service outages and the impact on service quality.
 - Notify the customer of possible service and/or quality implications.

2. Overview, continued

2.8 Power and Protection

This section discusses power requirements for the:

- ECI Digiloop PCM2U.
- Wescom DuaLine Plus.

2.8.1 ECI Digiloop PCM2U

Data on the power requirements of the PCM2U equipment is provided in the following table.

POWER REQUIREMENTS AND HEAT DISSIPATION					
UNIT	STATUS	POWER * WATTS	HEAT ** WATTS	ACTIVITY FACTOR	
COT	IDLE	2.9	1.1	.56	
COT	ONE LINE BUSY	3.7	3.1	.38	
COT	TWO LINES BUSY	5.9	4.3	.06	
COT		1.0	1.0	N/A	
* INCLUDES POWER DISSIPATED IN DSL RESISTANCE AND RT. ** EXCLUDES DSL AND RT DISSIPATION BUT INCLUDES CO LOOP POWER.					

The Activity Factor is the proportion of COT units expected to be in the given status at any time. The power requirement listed for the COT units includes the power supplied to the RT. The heat dissipation listed does not include the power dissipated in the line to the RT and the RT itself, but it includes power dissipated in the CO loop. ECI Digiloop equipment uses A2 limit voltage in all instances.

2.8.2 Wescom DuaLine Plus

The DuaLine Plus RT is powered by the COT equipment without using batteries or any power source at the RT location. The COT power unit converts -48 Vdc to the voltages required to power the RT. and COT equipment idle line voltage is within A2 limits: $\pm 80V$ tip-to-ground or ring-to-ground. Busy and ringing line voltage is within A3 limits: $\pm 140V$ tip-to-ground or ring-to-ground. The RT uses the line-powering voltage to:

- Power the 2B1 Q transmission.
- Provide battery to the subscriber.
- Generate ringing voltage.

DuaLine is a trademark of Charles Industries Ltd.

2. Overview, continued

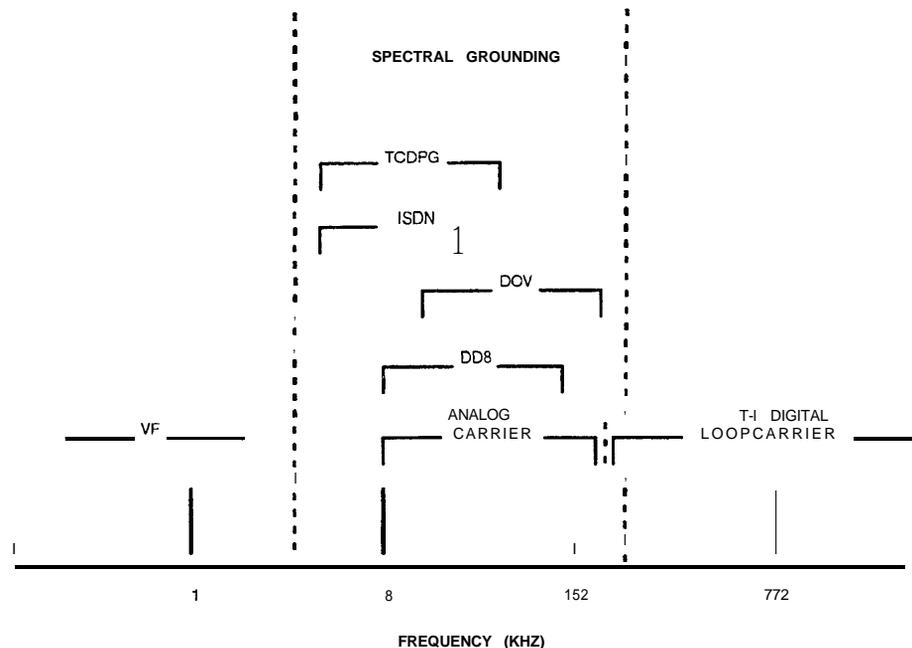
2.8 Power and Protection, continued

2.8.2 Wescom Dualine Plus. continued

The digital loop input primary protection against surges induced by lightning or other high-voltage transients is a three-element gas tube connected across the line and to earth ground. Secondary protection is provided to the electronics by clamping diodes on the secondary of the line transformer. The saturation characteristics of the line transformer attenuates some of the energy from the surge.

2.9 Spectrum Interference

Network transmission equipment that uses the 2B1 Q line code should not occupy the same cable sheath as an analog subscriber carrier. As documented in various reports, the 2B1Q transmission scheme causes severe noise on the analog subscriber channels and might cause carrier failures. Some of the enhanced services and/or frequencies that might adversely impact each other when placed in the same cable are shown in the following illustration.



2.10 Alarms

This section discusses the alarms provided by the:

- ECI Digiloop PCM2U.
- Wescom Dualine Plus.

2.10.1 ECI Digiloop PCM2U

Each PCM2U shelf provides external alarms as Form C relay contact closures. A system ID alarm, three minor alarm outputs, and three major alarm outputs are supplied. The system ID alarm is activated whenever an alarm condition exists in the shelf. One minor alarm and one major alarm might be manually deactivated by an Alarm Cut-Off (ACO) switch on the Shelf Power/Alarm Unit (SPAU). Also, a jumper option on the SPAU allows the two additional minor and/or major alarms to be under control of the ACO switch, if required.

2. Overview, continued

2.10 Alarms, continued

2.10.2 Wescom Dualine Plus

The COT line unit provides front panel Light Emitting Diodes (LEDs) that indicate the condition of the:

- COT line unit.
- Digital subscriber loop.
- RT.

The COT common unit provides front panel LEDs that indicate minor and major alarms. The COT shelf backplane provides contacts for connecting to external alarm indicators, or to alarm surveillance equipment for remote monitoring.

3. Ordering Information

3.1 ECI Digiloop PCM2U

Ordering information for the ECI Digiloop PCM2U is listed in the following chart.

Model No.	PSB ID No.	Description
40381Q-133-L3	360173	Card line COT PCM2U
40382Q-12-L2	360175	Unit RT PCM2U
40383T	357845	Unit shelf PWR/ALM PCM2U
40384Q	360305	Shelf PCM2U COT (wire wrap) 19"
40384I-11 -L2	357846	Shelf PCM2U COT (connectorized) 19"
40384T	357844	Shelf PCM2U COT (wire wrap) 23"
40384T-I 1 -L2	360172	Shelf PCM2U COT (connectorized) 23"
HD-19-3	357847	Baffle heat 3RU PCM2U 19"
HD-23-3	360174	Baffle heat 3RU PCM2U 23"
2280-I 7177-I 5	364918	Manual CO installation PCM2U
2280-I 7178-I 3	364919	Manual maintenance PCM2U
2280-17180-19	364920	Practice task-oriented PCM2U

(continued)

3. Ordering Information, continued

3.1 ECI Digiloop PCM2U, continued

Model No.	PSB ID No.	Description
2280-17261-10	364921	Instructions COT unit PCM2U
2280-17262-10	364922	Instructions RT PCM2U
2280-17184-10	364923	Instructions SPAU unit PCM2U
2280-16256-01	375971	Technical Manual (complete set)

3.2 Wescom DuaLine Plus

Ordering information for the Wescom DuaLine Plus is listed in the following chart.

Model No.	PSB ID No.	Description
DDL105RT	360307	CXR digital 2-pair RTU house mount (2)
DDL106RT	360308	CXR digital 2-pair RTU house mount (3)
DDL1 15RT	360311	CXR digital 2-pair RTU pole mount (2)
DDL201	357803	Shelf COT, 23" digital 2-pair CXR
DDL205	357804	Shelf COT, 19" digital 2-pair CXR
DDL210	342624	Unit power, COT digital 2-pair CXR
DDE21	357805	Unit common, COT digital 2-pair CXR
DDL235	357814	Unit line, COT digital 2-pair CXR
DDL390	357807	Unit line, COT digital 2-pair CXR AML SH

NOTE: (2) Two service connections
(3) Three service connections

4. Deployment Guidelines for TCDPG/DSC

4.1 Analog Carrier

Spectral interference is a valid concern, just as it is for all ISDN or ISDN-like services.

Network transmission equipment that uses 2B1Q line coding might interfere with analog subscriber carrier services. Under certain conditions, TCDPG/DSC might have a detrimental effect on analog subscriber carriers such as 84A, 82A, and CM-8 when in close proximity (i.e., same binder group). In such cases, it is likely that analog carrier systems might:

- Experience high levels of noise.
- Become unable to provide quality service to subscribers working on the analog subscriber carrier.

Physical separation within the cable reduces the level of interference generated. Therefore, TCDPG/DSC is deployed in a manner consistent with the best choice available from the following hierarchy.

NOTE: Because binder group separation (initial and ongoing) in the exchange plant is generally difficult, choice 1 below is always the preferred method.

1. No analog carrier in the same sheath.
2. Analog carrier and TCDPG/DSC in nonadjacent binder groups over the entire cable route.
3. Analog carrier and TCDPG/DSC in adjacent binder groups over the entire cable route.
4. If an analog carrier and TCDPG/DSC must be deployed in the same binder group, the following precautions must be taken:
 - A. All analog carriers in the same binder must be checked to determine if they are within noise limits. If so, no further actions are required.
 - B. If analog carriers are not within noise limits, verify that the carrier in question is operating within stated limits. Correct if needed.
 - C. If the problem still exists, one of the following actions must be taken:
 - 1) Move the TCDPG/DSC to a different binder group.
 - 2) Move the analog carrier to a different binder group.
 - 3) Vacate channels 5 and above on the carrier.

NOTE: The continued use of obsolete analog subscriber carriers will continue to hinder deployment of enhanced services. They are incompatible with ISDN, and will also be incompatible with High bit rate Digital Subscriber Line (HDSL) repeaterless T1 technology, as well as any new services that use the standard 2B1Q line format.

4. Deployment Guidelines for TCDPG/DSC, continued

4.2 Loop Loss Limits

The range of the digital subscriber loop should be less than or equal to 1300 ohms or 42 dB loss at 40 kHz with no load coils.

The following loss factors should be used when calculating loss for digital subscriber loops.

CABLE GAUGE	LOSS FACTORS IN dB/Kft AT 20 kHz				LOSS FACTORS IN dB/Kft AT 40 kHz			
	PULP CABLE		PIC/FOAM CABLE		PULP CABLE		PIC/FOAM CABLE	
	AERIAL 120°F	BURIED 70°F *	AERIAL 120°F	BURIED 70°F *	AERIAL 120°F	BURIED 70°F *	AERIAL 120°F	BURIED 70°F *
19	0.78	0.70	0.72	0.66	0.92	0.84	0.91	0.76
22	1.29	1.19	1.23	1.14	1.52	1.38	1.42	1.30
24	1.78	1.65	1.72	1.61	2.13	1.96	2.04	1.88
26	2.31	2.18	2.33	2.18	2.87	2.66	2.86	2.66

* USE 70°F FOR DIRECT BURIED AND UNDERGROUND FACILITIES.

4.3 Design Requirements Loop Prequalification

Information in this section is to be used by OSP Engineering personnel to prequalify selected OSP loops for TCDPG/DSC deployment. This procedure is to be performed until the OSP facility records are populated and maintained in the Interactive Computer Graphics System (ICGS)/Micro WPG systems, at which time the ICGS/Micro WPG systems will be used to prequalify the cable loops.

TCDPG/DSC loops are prequalified for suitability based on the following criteria:

- A loss calculation is required before qualification. The total loss (including bridge taps) must be less than or equal to 42 dB at 40 kHz and no more than 1300 ohms. See loss factors in the chart in Section 4.2. This calculation must include the CO, customer wiring, and bridge tap of no more than 2500 feet.
- There must be no load coils in the cable complement serving the customer loop; only nonloaded cable can be used.

NOTE: Load coils are not permitted because TCDPG/DSC does not work on loaded cable.

- As a first choice, the loops should be located in a cable sheath that is void of analog carriers. See Section 4.1 for deploying guidelines when installing TCDPG/DSC in the same cable as the analog carrier.

5. Departmental Responsibilities

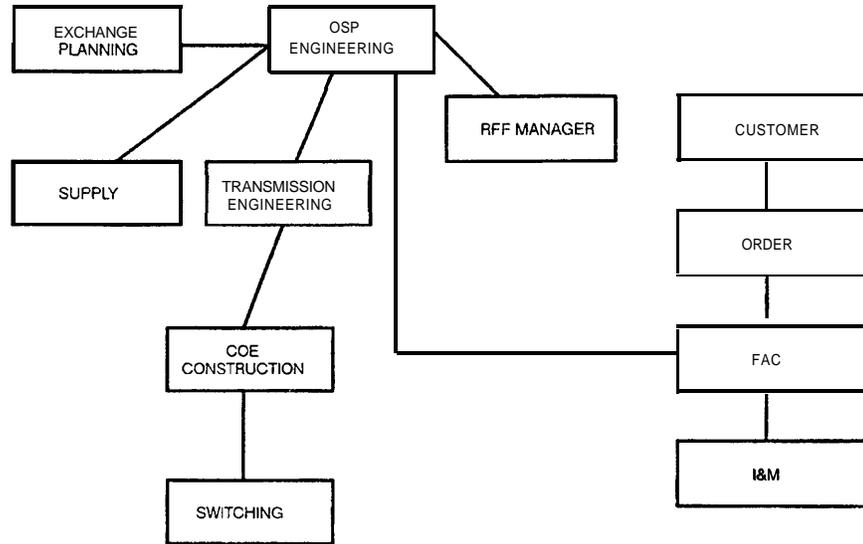
5.1

Use of Flowchart

The following flowchart should be used as a guideline when implementing TCDPG/DSC in a GTE Area.

The flowchart defines all functional departments that have a major role in implementing TCDPG/DSC to serve GTE's customers.

Each functional area has determined that the responsibilities included on the flowchart are properly assigned.



5. Departmental Responsibilities, continued

5.2 Departmental Order Flowchart

This section describes each department's responsibilities regarding the provisioning process for deployment of TCDPG/DSC:

1. Exchange Planning determines which CO routes are potential candidates for TCDPG/DSC deployment (1300-ohm loops) and identifies feeder routes where analog subscriber carrier is not deployed or identifies the time frames for removal in those areas in which the analog subscriber carrier is deployed. Exchange Planning sends this information to OSP Engineering.
2. OSP Engineering reviews routes for qualifications as shown in Section 4.3.
 - A. If routes do not qualify, the cost-effectiveness of qualifying the loop must be determined.

If Qualifying the Loop Is...	Then...
Not cost-effective	Retain information for future use.
Cost-effective	Issue the documentation needed to generate OSP work order following normal operating procedures.

B. If routes qualify:

- 1) OSP Engineering must generate a transmittal to the appropriate Reserved Future Funds (RFF) manager for their region to identify the need for TCDPG/DSC and the total dollars required. The RFF funds should be transferred from (OSP Account) with a copy to Exchange Planning. The RFF manager responds to OSP Engineering that the funds were transferred to (CO Account).

NOTE: **This RFF information is required before equipment can be ordered and must be a part of the carrier request.**

- 2) Once the RFF is established, OSP Engineering submits a request to Transmission Engineering to order the COT portion of TCDPG/DSC. This should include the wire center, vendor name, number of shelves required, number of cards required, estimated in-service date, RFF designation for budget purposes, and contact name and number.

NOTE: **A copy of this request should be sent to the local supply point supervisor as notification of the proposed installation of the COT Upon this notice, supply stocks the RTs using normal operating procedures.**

- 3) Transmission Engineering develops the documentation, including the OSP contact name and number, required to complete the order for the COT equipment.
- 4) Transmission Engineering notifies OSP Engineering when the work order is complete, including CO work order number.
- 5) RTs are stocked locally. COT equipment is not stocked, but is placed as requested.
- 6) Central Office Equipment Construction (COEC) installs the CO portion of TCDPG/DSC and performs normal testing procedures.
- 7) Switching accepts work performed by COEC, performs cutover, and turns up the system.
- 8) COEC notifies OSP Engineering that installation is complete.

5. Departmental Responsibilities, continued

5.2 Departmental Order Flowchart, continued

- 9) Within eight working hours of notification from COEC that COT installation is complete, OSP Engineering configures new carrier information into Mechanized Assignment Record Keeping (MARK). This is done using the MARK identifier SDCnnn-System #, Channels 1 and 2 (where SDC is Subscriber Digital Carrier, and nnn is Wire Center Location code), just as AML or 84A carriers are shown in MARK today.

NOTE: This information was submitted to the MARK Operation Managers in a letter dated August 21, 1992, from B. Jeffrey Tasker, Magager-FMS/FAC Support.

- 10) OSP Engineering notifies Facility Administration Center (FAC) of affected counts for flagging. Flagging identifies that a certain count is qualified for deployment of TCDPG/DSC.

NOTE: FAC will not assign TCDPG/DSC without approval from OSP Engineering.

- 11) As OSP Engineering receives "No Facilities" service orders, they review each order to determine whether or not TCDPG/DSC should be deployed. Once the service order is received whether or not TCDPG/DSC is deployed, OSP Engineering should follow normal procedures for referred service orders as described in GTE Telephone Operations Practice 938-01 O-001.

- 12) I&R/Cable installs the RT portion of the TCDPGIDSC and performs normal testing.

3. OSP Engineering must monitor current fills of TCDPG/DSC on a quarterly basis by using MARKER Reports, which can be accessed through MARK.
4. OSP Engineering must monitor TCDPG/DSC disconnects through MARK on a monthly basis. These disconnects are identified with a Left In Facility (LIF) status just as copper disconnects are shown today. Based on individual activity in each area, a determination should be made locally as to whether it is economically feasible to dispatch personnel to remove units for reuse.

6. Accounting Interpretations

6.1 Description

The accounting interpretations are:

- COT has Account 223221 (Digital Subscriber).
- RT has Account 236291 (Subscriber Pair Gain), whether mounted at the house, pole, or pedestal.

7. Installation

7.1

Description

The TCDPG device is an enclosure that can be mounted near the service wire on an outside wall at the customer's residence or business. The RT can serve as a Network Interface Device/Standard Network Interface (NID/SNI) when installed at the customer's premises.

CAUTION: The TCDPG device contains circuitry to derive two POTS lines from the subscriber's single-line facilities; therefore, handle the device carefully to prevent damage to internal components.

Use the following procedure to install the RT at the customer's site.

Step	Installing the RT at the Customer's Site
1	Select a flat, vertical surface in a location with easy access to the telephone drop line.
2	Drill two appropriate-size pilot holes (sheet metal, wood, masonry, etc.) for #8 hardware (0.164 inch diameter) with a vertical spacing of 9 inches for both the ECI and Wescom units.
3	Hold the housing against the wall so that the holes of the mounting ears are aligned with the holes drilled in Step 2.
4	Insert the mounting hardware into pilot holes and tighten until the screws hold the housing firmly against the wall.
5	Open the main access door of the TCDPG housing.
6	Use a pointed scratch awl to puncture a small hole in the center of the grommet that covers the drop wire entrance and the station wire entrance. NOTE: To prevent insect infestation, do not make the hole larger than necessary.
7	Push the drop wire, station wire, and ground wire through the respective grommets. Strip insulation from the wires and connect to terminals as shown on the connector terminal assignment diagram inside each RT.

8. Turn Up Testing for Remote Terminal

8.1 Description

The testing procedure is outlined in the following chart.

Step	Testing-Remote Terminal
1	Using the telephone test set, clip the leads to line 1 red and green terminals and initiate a test call to the CO .
2	Alternately connect the telephone dial test set to the station wire connections and check for normal operation.
3	Arrange to have a call initiated from the CO to the TCDPG location. NOTE: Repeat these steps for the second line.
4	At the ECI unit, verify that the line voltage (tip to ring) is at least 128V with both phones on-hook. At the ECI unit, verify that the tip-to-ground and ring-to-ground voltages are within 3V of each other.
6	At the Wescom unit, verify that the line voltage is -50 to -150 Vdc and that tip-to-ground and ring-to-ground is less than -80 Vdc.

9. Troubleshooting

9.1 Description

The troubleshooting for unit operation can be accomplished by using the testing procedure described in Section 8. A defective unit that is inoperative must be replaced.

NOTE: Manufacturers' maintenance manuals will provide specific electrical and physical characteristics.