British Rail

TECHNICAL TRAINING NOTE APT/8.2

CONTROL - APT SYSTEM (C-APT)

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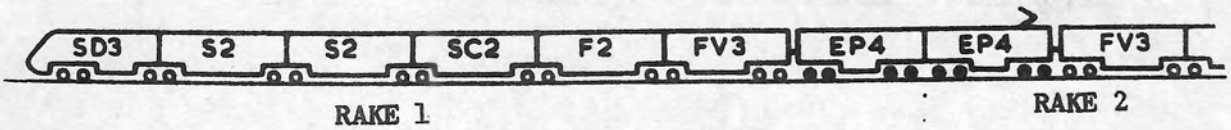
RAILWAY ENGINEERING SCHOOL,
BRITISH RAILWAYS, DERBY.

APT	8.2		F2

APT-P TRAIN FORMATION CODES

250 km/h (2+12) high-powered version (prototype)



OPERATORS CODE: DTS TS TS TRB TF TBF M M TBF

DTS:-	Drg. Trailer Second	or	Second Drg. (3 axles)	SD3
TS :-	Trailer Second	or	Second (2 axles)	S2
TRB:-	Trailer Rest/Buffet	or	Second Catering (2 axles)	SC2
TF :-	Trailer First	or	First (2 axles)	F2
TBF:-	Trailer Brake First	or	First Van (3 axles)	FV3
M :-	Motor	or	Elect Power (4 axles)	EP4

BRITISH RAIL

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C-APT SYSTEM

1. INTRODUCTION

The Advanced Passenger Train (APT) has been designed to negotiate curves at speeds roughly 30% higher than conventional restrictions. A new series of higher speed restrictions has been agreed for APTs.

The same train crews will operate APTs as well as conventional trains and it is not advisable for them to memorise, for a given route, two sets of speed restrictions without risk of confusion.

The purpose of the Driver Aid System (C-APT) is

1.1

Primarily to warn the driver by sounding a horn at the commencement of a speed restriction and to display the correct track speed for that restriction.

If this warning is not acknowledged by the driver the system will automatically apply the train brake via the Emergency Brake Loop EBL.

1.2

Secondary use is to avoid pressure changes inside all vehicles entering a tunnel by closing off for a short period the air exits on the coaches by sealing valves.

Figure 1 shows the equipment associated with the system and it can be broken down as -

ITEM		LOCATION
1. Transponders	(Various)	Track
2. Aerials	(2 off)	Bogie BT12 BT11A
3. Transmitter/Receivers	(2 off)	Adjacent to Aerials
4. Tacho Generators	(4 off)	2 Axles each end
5. Processors (Dual Main/Standby)		D.A. Compt
6. Display Unit	(1 off)	Desk
7. Horn	(1 off)	Desk
8. Reset Switch	(1 off)	Desk
9. Speed Restriction Lamp	(1 off)	Desk
10. Indicator	(2 off)	LH Cab Side
11. Power Supply Boxes	(2 off)	Electronic Bay

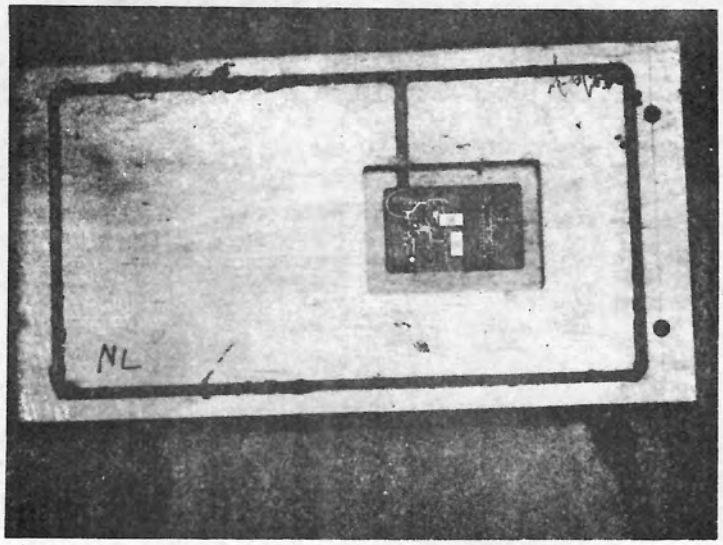


Fig. 2. Underside view of Transponder prior to sealing and Encapsulation.

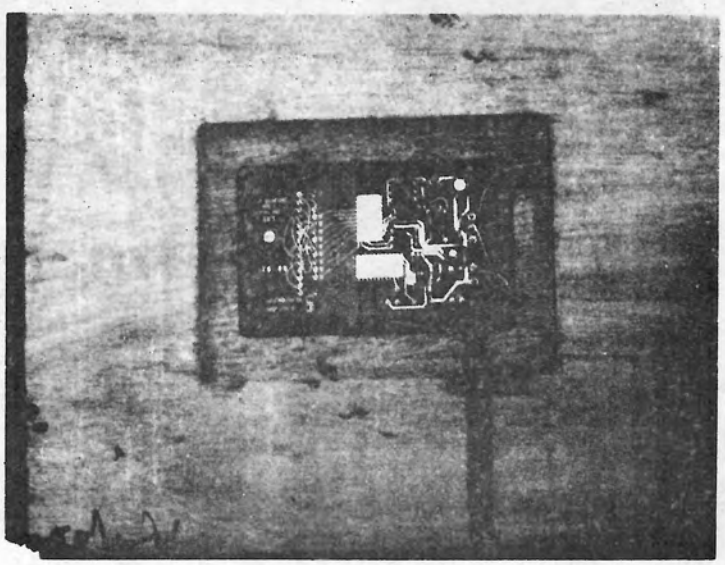


Fig. 3. Close up of Transponder Cavity showing programmable Circuit Board.

2. TRACK EQUIPMENT

2.1 Transponders

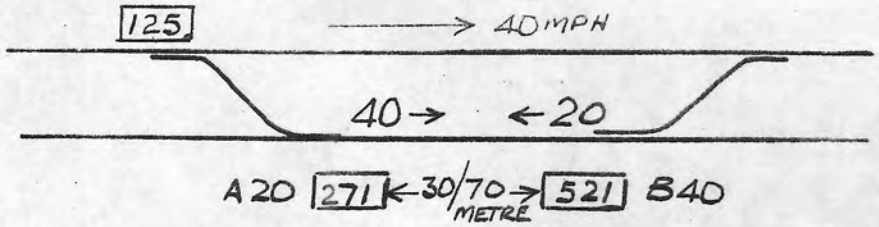
A transponder is a unit that can be bolted onto the track (Fig 2) and contains a radio transmitter which, when activated, transmits a constantly repeated code "telegram". Power for the transmitter is provided by a "crystal set" type of radio receiver in the transponder which thus requires no external power supply.

Two types of tansponder exist - those that are coded before encapsulation and those that can be coded after encapsulation.

The transponder may be coded by connecting together combinations of pins. The recessed area is then filled and sealed.

2.2 Code Letter

A)
B) Directional Transponders) AC
) AD
) AF



C Commencement Transponder only occur as C - 000

D Diverging Junction

1. Displays J in Cab
2. Switches to 500 m instead of 1 km

E Experimental Transponder

No direct influence on C-APT System.

E763 Research Purpose
E773 Tunnel - Close Air Valves on Coaches
E775 Low Power Test - Suicide for Processor
E776 Monitor - Platform By-pass check

F - OFF Transponder - End of fitted track shuts down display

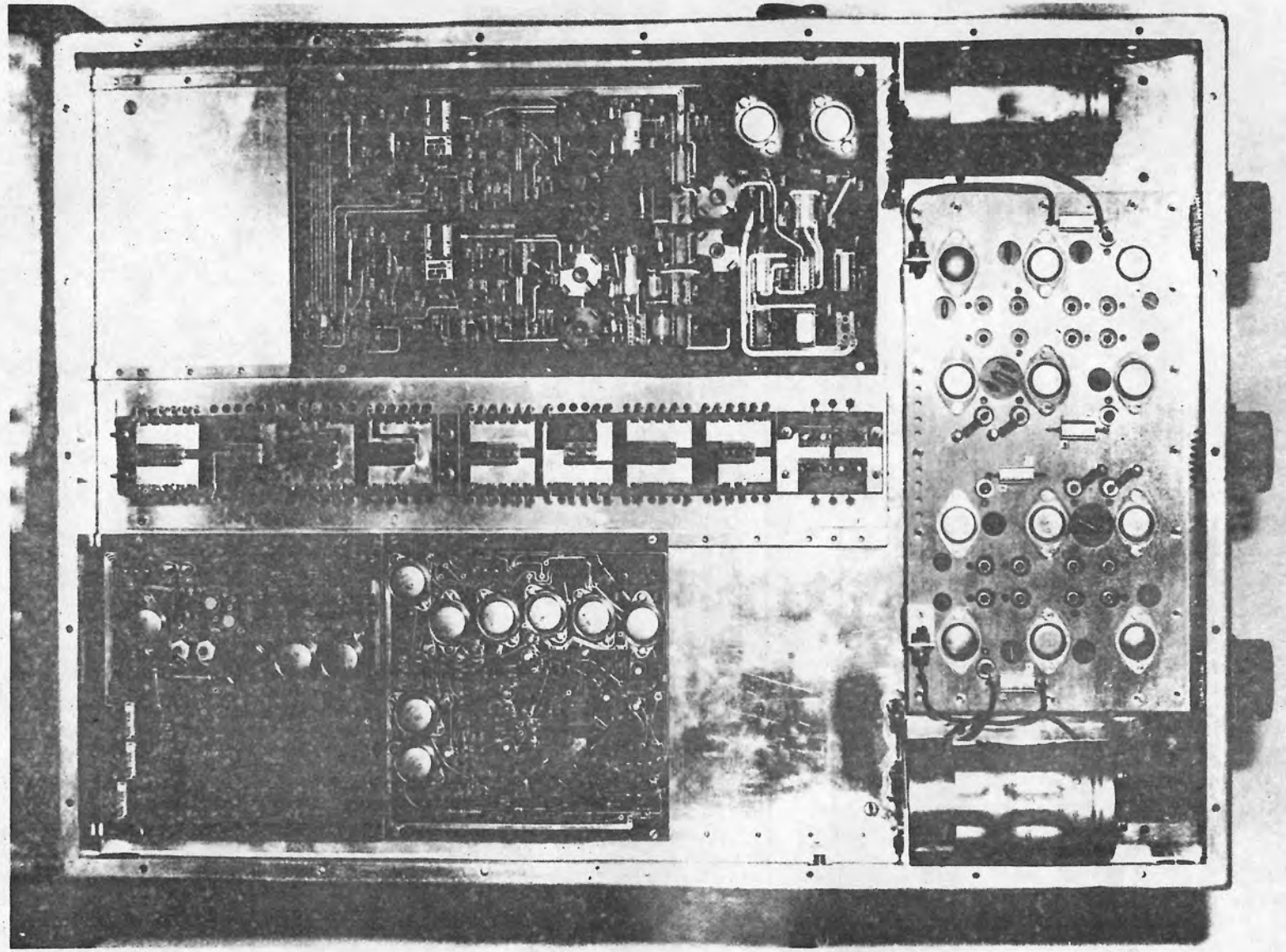


Fig. 3. Processor Auxiliary Side
(Relays & Wiring Harness Omitted)

3. VEHICLE BORNE EQUIPMENT

3.2 Aerial

Power is transmitted to the transponders and returning signals are picked up by an aerial on one bogie. Both the leading bogie of APT (Type BT12) and the second bogie (BT11A) are fitted with aerials, the former is used for the "main" system and the latter for the "standby" system. The aerials take the form of loops of tube roughly 3 m x 0.5 m.

3.3 Transmitter/Receiver

The train continuously transmits radio frequency power (at 147 kHz) and, when it passes over a transponder, this power is received and used to drive the transmitter. The transmitter constantly repeats its coded message for as long as it receives power. (The message is 80 bits long, phase modulated on a 73.5 kHz signal).

3.4 Speed Tacho Generator

The actual speed of the train is measured by 4 small toothed wheel type generator. (2 per axle)

3.5 Processor

The two identical processor units (Fig 3) are housed in the back wall of the cab. One is usually operational and the other is a standby. Each unit comprises a transmitter/receiver, display drive and various auxiliary circuits accessible from one side and a processor and check processor accessible from the other side. The signal connections between the two sides of the unit are made via opto-isolators (devices comprising light emitting diodes and light sensitive transistors allowing data transfer without electrical contact, which could otherwise be let through interfence into the processor).

3.6 Cab Display

In front of the driver is a digital speed display comprising two drums rotated by stepper motors. The position of each drum is checked by a row of photocells which are illuminated through coded rows of holes in the drums. There is a shutter in front of the display and, when a valid number is not displayed the shutter drops.

3.7 Horn

An audible warning (an electronic device producing a repetitive rising note).

3.8 Reset Button

A reset button to cancel the audible warning and so prevent brake application.

3.9 Speed Restriction Lamp

A "restriction commencement" light which is illuminated for 4 sec at the point where a speed restriction change becomes executive.

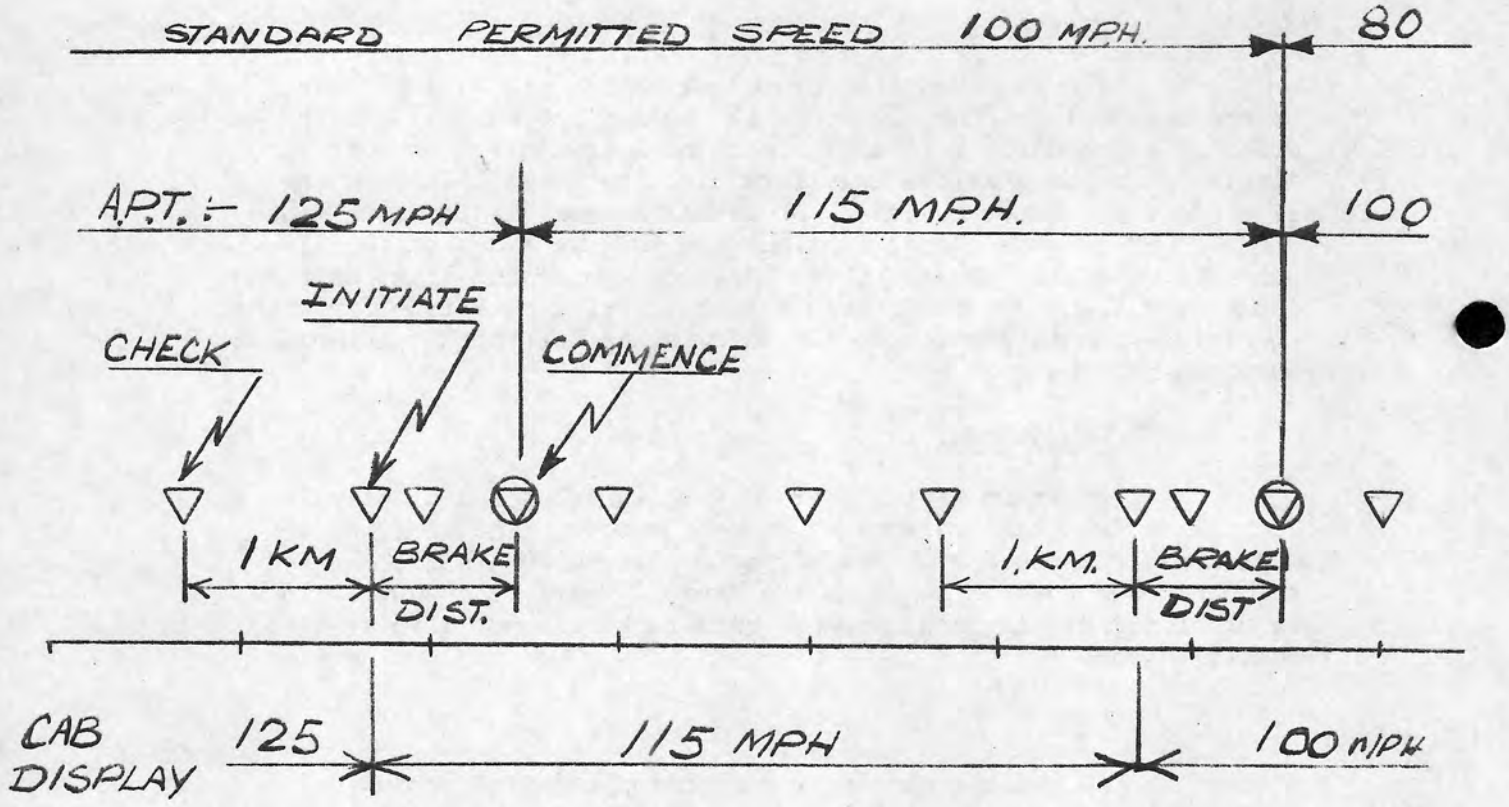
3.10 C-APT System Light

A "system available" light located L.H.S. panel.

3.11 Power Supply

Two electronic boxes/located in the under floor bay) to provide the required + 25 v/OV/-25 v for the system.

One is the main and uses the 3 ph 415 v input the other is standby and use 110 v D.C. input.



"CHECK" TRANSPONDER :- RESET DISTANCE COUNTER
"INITIATE" " :- HORN - DISPLAY - RESET
"COMMENCE" " :- FLASH LIGHT

4. OPERATION

4.1 Commissioning

Place the master selector to FOR/AUX/REV this will via wire D60 and C-APT isolator switch energise the C-APT supply contactor which will switch on the 3 ph 415 v and 110 v D.C. input to AC/DC - DC/DC supply units.

After10 sec delay C-APT horn should sound.

Cancel this via the reset button and now the speed restriction lamp should light up for 4 sec.

Check that both C-APT systems are available by L.H.S. indicators.

4.2 Simple Permanent Speed Restriction (PSR)

Approaching a permanent speed restriction, and at a sufficient distance in rear of the commencing point to enable the necessary reduction in speed to be made. The train will pass over a "check" transponder which will reset the distance counter.

A further 1 km onwards the train will pass over an "initiating" transponder at which an audible warning will sound in the cab and the speed displayed will change to the lower permitted speed. The Driver will be required to acknowledge the audible warning and, if he fails to do so, the brakes will be applied automatically.

The actual commencement point of the restriction will be indicated to the driver by the desk speed restriction light coming on for 4 sec.

4.3 Higher Speed Permitted

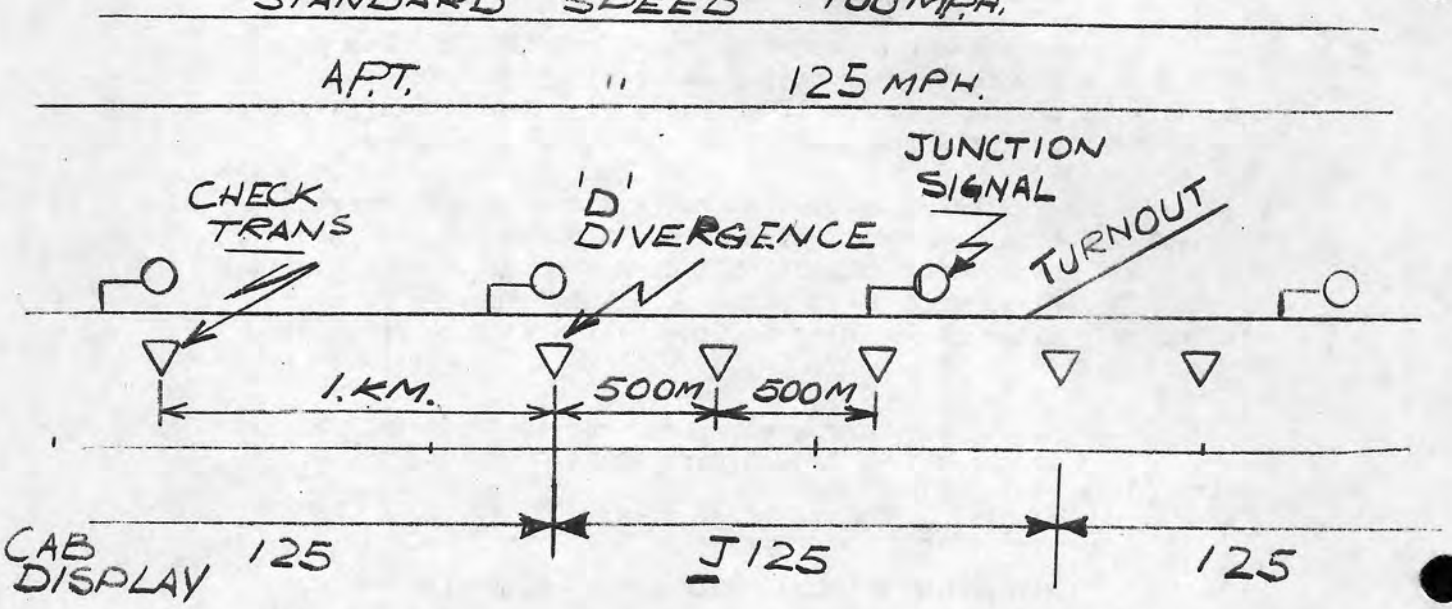
On reaching a point where speed may be increased, a short distinctive audible indication will be given and the higher permitted speed will be displayed. This audible indication will not require to be acknowledged.

4.3 Junction

Approaching a junction the train will pass over a 'D' type transponder, the letter "J" will be displayed alongside the higher permitted speed. This display will be given irrespective of whether or not the junction signal is showing a proceed indication and irrespective of which route is cleared for the train.

If the junction signal clears for a diverging route, the Driver must observe the speed restriction applicable to that route, as shown in the Sectional Appendix, in the normal way.

This "approaching junction" display will be retained until the train has passed over the junction(s) whereupon the subsequent permissible speed alone will be displayed or, if the train passes to an unfitted route, the cab display will be extinguished.



4.4 Failures

Should there be a failure of the system, the cab display will be extinguished.

The cab display will also be extinguished on the approach to a planned temporary speed restriction.

Loss of cab display will be accompanied by the audible warning which the Driver will require to acknowledge.

If a temporary speed restriction has to be introduced at short notice Drivers will be verbally advised until arrangements can be made for the track equipment to extinguish the cab display.

4.5 Summary of C-APT Indications

1. Permanent Speed Restrictions

a) At braking distance from restriction	Audible Warning Display changes to lower speed	Acknowledge by pressing CAPT cancel button
b) At commencing point	Short-duration light. No audible warning	No action
c) At end of restriction	Short audible advice. Display changes to new speed.	No action

2. Temporary Speed Restrictions

a) At point of suppression giving more than braking distance from restriction.	Audible Warning. Display extinguished	Acknowledge by pressing CAPT cancel button
b) After passing 'T' board *	Short audible advice. Display restored.	No action

3. Facing Junctions

a) Immediately in Rear of overlap track circuit joint of signal in rear of junction signal.	'J' indication appears alongside permitted speed display. No change in speed display. No audible advice	No action. Drive in accordance with signal aspects
b) Beyond junction:		
i) If on fitted route	'J' indication extinguished. Speed display as appropriate for the route. No audible advice	No action
ii) If diverted to unfitted route	As 4 (a)	Acknowledge by pressing CAPT cancel button. Drive as conventional train

4. Running on Unfitted Route

a) At commencement of unfitted route	Audible warning. Display extinguished	Acknowledge by pressing CAPT cancel button. Drive as conventional train.
b) At entry to fitted route from unfitted route *	Short audible advice. Display restored	No action. Drive as APT

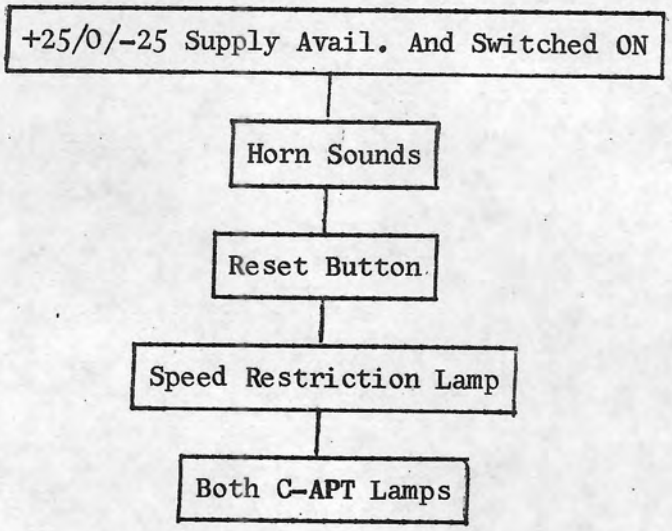
5. Failure of CAPT Equipment

a) When failure occurs	Audible warning. Display extinguished	Acknowledge by pressing CAPT cancel button
b) When system restored after failure *	Short audible advice	No action

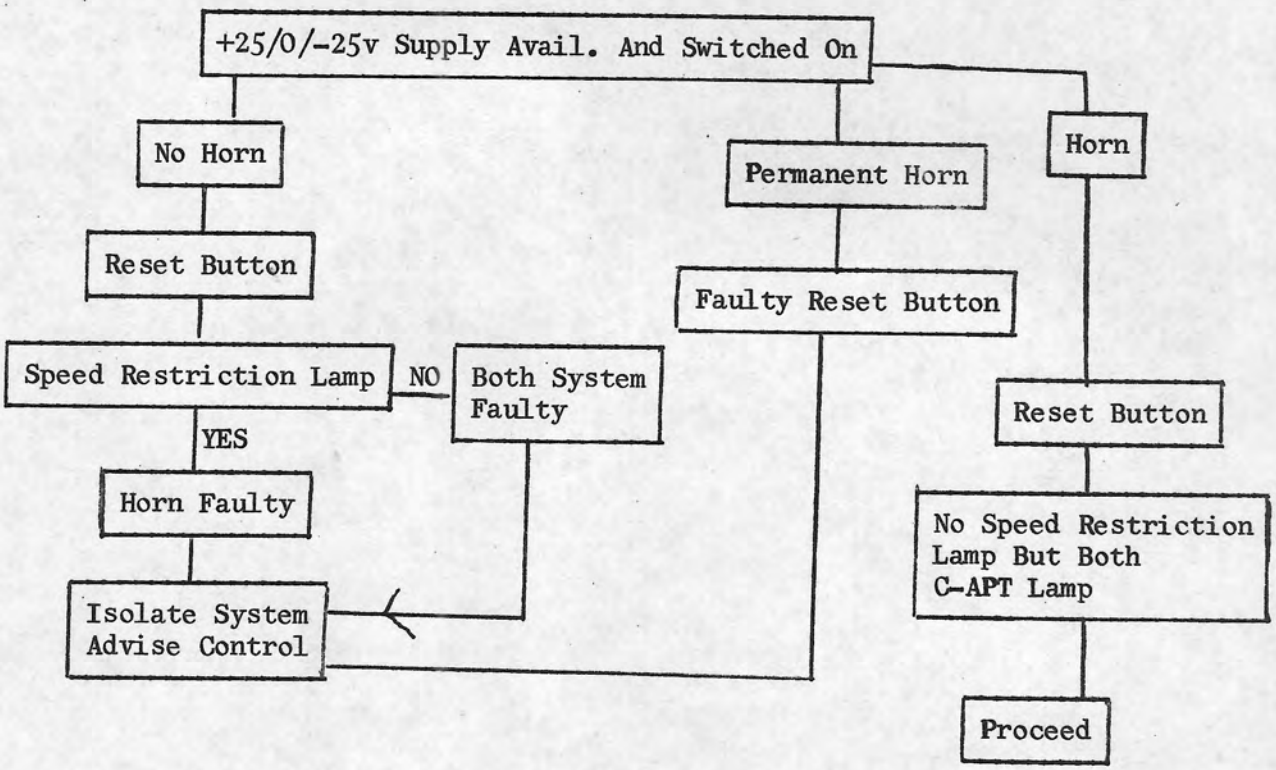
* Audible advice given at first valid transponder beyond the point concerned

5. FAILURE GUIDE (COMMISSIONING)

NORMAL OPERATION



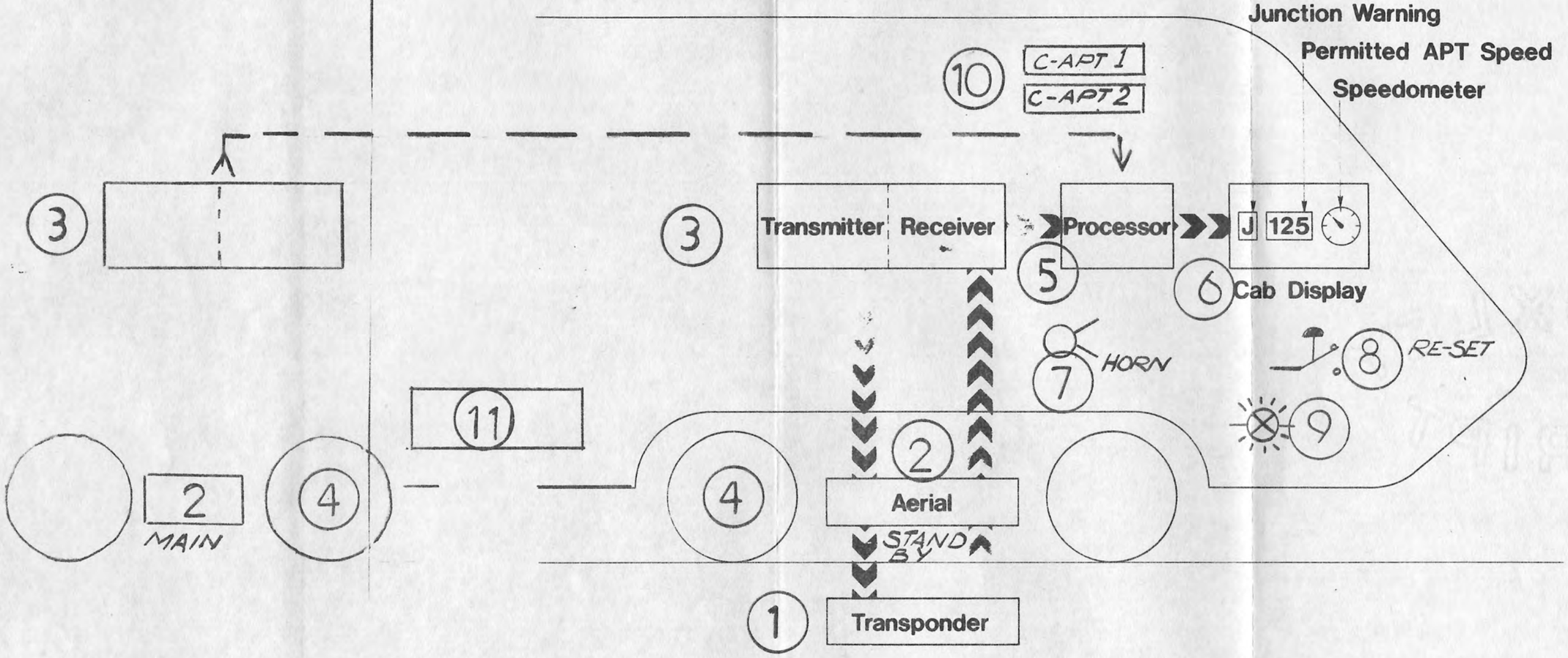
FAULTY OPERATION



STUDENTS NOTES

DIS-049

DRIVER AID SYSTEM FOR APT



OPERATION :-

1ST PROTECTION TRANSPONDER } 1KM 2ND INITIATING TRANSPONDER } BRAKING DISTANCE } 3RD COMMENCE TRANSPONDER

HORN → CANCEL BY DRIVER → 4SEC LIGHT

DISPLAY → NOT CANCELLED → AUTO-BRAKE