APPLICATION NOTE

User Manual of High-End RDS/EON Car Radio System CCR612 (V0.3)

AN96029

User Manual of High-End RDS/EON Car Radio System CCR612 (V0.3)	Application Note 96029

Abstract

The CCR612 is a computer controlled car radio system based on a P83CE528 micro controller. It controls a high-end AM/FM car radio with RD(B)S, EON and various I^2C controlled peripherals. It can be interfaced to a SCC600 CD-changer

The system contains functions such as PLL tuning, IF control, stereo decoding, RDS/RBDS+EON decoding, IAC, sound switching, sound fader control, LCD display, cassette interface, external audio input jack and a detachable front. An interface to control a CD-changer is also provided.

Radio control and RDS/RBDS+EON processing are combined in a single microcontroller.

Purchase of Philips I^2C components conveys a license under the I^2C patent to use the components in the I^2C system, provided the system conforms to the I^2C specifications defined by Philips.

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Summary

CCR612 is a computer controlled car radio system based on a P83CE528 microcontroller. It controls a high-end AM/FM car radio with R(B)DS (Radio Broadcasting Data System), EON (Enhanced Other Network) and various I^{2}C-bus controlled peripherals.

The system contains functions such as PLL tuning, IF control, stereo decoding, RDS/RBDS+EON decoding, IAC, sound switching, sound fader control, LCD display, cassette interface, external audio input jack and a detachable front. An interface to control a CD-changer is also provided.

Radio control and RDS/RBDS+EON processing are combined in a single microcontroller.

CONTENTS

Modification with respect to old documents:

This document replaces the following two documents:

User Manual of Computer Controlled Car Radio System CCR612 V0.2	AN95081
Diagrams and Performance of R(D)BS Car Radio CCR612 with Cassette Deck and CDC Changer (V1.1)	AN95070

Change history of: User Manual of High-End RDS/EON Car Radio System CCR612S

Modifications with respect to the application note " User Manual of High-End RDS/EON Car Radio System CCR612S (Version 0.2)", report number AN95081.

1.   Added use of more types of Sofac(TEA6320, TEA6321, TEA6322, TEA6323), adapted sound setting
2.   Band selection diode 2 moved to other pin
3.   Sleeptimer changed from 30 minutes to 1 hour

Modifications with respect to the application note " User Manual of High-End RDS/EON Car Radio System CCR610S (Version 0.1)", report number AN94065.

1.   TEA6821 replaced by TEA6822.
2.   Frequency counter resolution for FM changed from 5 kHz to 6.25 kHz.
3.   Volume level during traffic announcements made adjustable by the user in the option programming menu.
4.   PTY search algorithm changed.
5.   Functionality of PTY icon changed.
6.   Manual tuning algorithm changed.
7.   For MW band only tuning on grid is possible.
8.   Manual tuning grid for USA option changed from 50 kHz to 100 kHz.
9.   Search tuning grid for USA option changed from 100 kHz to 200 kHz.
10.   Pin 9 of the microcontroller (SECUR) not used any more (security functionality stays the same).
11.   Input added for "Phone mute".
12.   Checking on not initialized EEPROM and preprogramming them with default values (listed in appendix II) at radio switch on.
13.   Polarity of pin EXSTAT changed.
14.   Crystal frequency of microcontroller changed from 8.664 MHz to 12 MHz.
15.   PTY code not longer stored in EEPROM.
16.   When RDS regional mode is on, the radio is now also allowed to switch over to stations with the same PI-code but its regional code set to "Supra regional".
17.   Display message during AST search changed from "AST SCAN" to "STORE".

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Change history of: Diagrams and performance of R(B)DS Car Radio CCR612 with Cassette Deck.

<u>DIFFERENCES WITH PREVIOUS CCR612 (AN95070).</u>

Mainboard part 1:
   Two diodes were added to improve reset behaviour
   In case a static on/off key is used, C144/C154/C151 must be 10µF i.s.o. 100nF.

Mainboard part 2:
   Option diode D8 is removed. Option diode D2 is now connected to pin 21.
   Option diode D4 and D6 are removed.

<u>DIFFERENCES WITH PREVIOUS CCR612 (AN94067).</u>

This note, Diagrams and Performance, valid for CCR612 radio sample (version D) controlled by CCR610S or CCR612S software (the latter, also for CDC-changer control), differs mainly from the previous one (Version 1.0) by the following modifications and corrections.

<u>Modifications and Improvements.</u>

General:
   Component numbering CCR612 radio sample. Unlike previous note, the electrical component numbers of the PCB boards (Fig. 13b and Fig. 13d) do match with the electrical diagrams (Fig.4, Fig.7 and Fig.9), which belong to the CCR612 radio sample (Version D).

Main Board part 1a, 1b and 1c (pages 14, 15 and 16).

   - A CDC-changer interface circuit has been introduced, using an extra TDA8579T and intended for CDC-changer SCC600, controlled by CCR612S software.

   - Switched battery voltage circuit improved. Which delivers for external use a battery voltage only when the radio is in the Power On mode for; supplying the illumination of the detachable front and delivering a switched plus voltage for the line-out, motor antenna and CDC-changer.

   - A telephone mute circuit between Connector Block and Micro Controller pins (AUMUTE and OPTROW) has been introduced. For this feature the former security contact is used. In general this is not a problem because the trend to use a security contact is decreasing by the use of detachable fronts.

   - **For part 1c only,** the bleep input is moved from the source selector (HEF4052B) input to the Audio Pre Amplifier (TDA6320T) input.

Main Board part 2a and 2b (Page 17 and Page 18).

- Telephone mute circuit, between optrow (40) and Aumute (43) introduced.

- The use of one crystal (8.66 MHz) for both micro and RDS demodulator is not possible in this set. Because for improved RDS behaviour more 'speed' is needed which requires a crystal of 12 MHz for the micro and 8.66 MHz or 4.33 MHz for the RDS demodulator.

- **For part 2b only,** in the lines ON/OFF, DATA and SCL between detachable front and micro ESD protection circuits are introduced which consists of a few resistors, zener diode 5V6 (BZX79C) and 2 diodes (BAV99).

Key and Display panel SB1b (Page 21).

- Following a now a days trend the power switch, in the ON/OFF radio line,is moved to the detachable front. That means two extra contacts on both detachable front and radio are needed.

Diagram ICE Module (page 22).

- The diagram of the ICE module (Euro 1, standard) is modified, the "second" IC TEA6821 is replaced by the successor TEA6822.
- The diagram of the ICE module (Euro 1, standard) is modified, the "second" IC TEA6821 is replaced by the successor TEA6822.
  Improvements of the TEA6822 with respect to the 6821:
  At AM.
     - Sensitivity higher. Distortion and AM and AF output less fieldstrength dependent
  At FM.
     - Interference Absorbtion improved by double detection.
     - Gain less temperature dependent
     - AM to FM switching in less then 0.5 seconds
  With respect to software control.
     - Level ADC extended from 3 to 4 bits.
     - Multipath sensitivity to be set.
     - Level temperature coefficient to be chosen (1 bit) for CDSP applications.
     - Counter pre-scaler setting added to reduce counter time.

1   INTRODUCTION

CCR612 is a computer controlled high-end AM/FM car radio system with R(B)DS (Radio Broadcasting Data System), EON (Enhanced Other Network information) and I^{2}C-bus controlled radio IC's. CCR612S is the controlling microprocessor. CD-changer control is also preformed by the CCR612S. It is based on the 8051 family microcontroller P83CE528 and takes care of all radio control functions as well as R(B)DS and EON decoding. With the following features:

- Digital PLL tuning for FM, MW, LW and SW (49m) bands, (factory options: MW, LW and SW disable).
- Factory option for application in different parts of the world (e.g. USA / Europe) concerning the band limits and tuning grid.
- Manual Tuning, Search Tuning and Local/Dx handling.
- Frequency Scan (Continuous Search, pausing 6 seconds on every station).
- Automatic Store Tuning (AST).
- Search for Traffic Programmes (TP) or specific Program Types (PTY).
- Presets: 6 in each of the bands: FM1, FM2, FM-AST, MW, MW-AST, LW and SW (49m).
- R(B)DS functions:
  - PS   Programme Service name.
  - PI   Programme Identification code.
  - AF   Alternative Frequency List / Automatic Following.
  - TP / TA   Traffic Programme / Traffic Announcement.
  - PTY   Programme TYpe selection and display. PTY Code table for both RDS and RBDS.
  - EON   Enhanced Other Networks information.
- Sound control: volume, bass, treble, balance, fader, loudness and mute via I^{2}C-bus or potentiometers.
- Non Volatile Memory for last sound control settings, last band, last frequency for each band, Presets, PS names (RDS), AF lists (RDS), etc.
- LCD display (I^{2}C bus controlled) displaying:
  - system status (band / frequency / preset number / modes).
  - RDS Programme Service name (PS).
  - RDS Programme Type (PTY).
  - Sound control settings (Bass, Treble, Balance, Fader).
- Power stabilizer control with diagnostic functions.
- User control up to 27 keys with either a fixed keyboard, a keyboard on a detachable front or a combination of both.
- User programmable options.
- Cassette Interface including MTL, Dolby, AMS (Automatic Music Search) and Solenoid control.
- Input jack for external audio source.
- Input for phone mute detection.
- An interface for the SCC600 CD-changer.

1.1 Definitions, Acronyms and Abbreviations

AF	Alternative Frequencies (R(B)DS-information) / Automatic Follow;
AMS	Automatic Music Search;
AST	Automatic Store Tuning;
EON	Enhanced Other Network (R(B)DS-information);
I^{2}C	Inter-IC bus;
ICE	In Car Entertainment;
LCD	Liquid Crystal Display;
MTL	Metal (versus Chrome/Ferro) type of tape;
NVM	Non Volatile Memory (EEPROM);
PI	Programme Identification (R(B)DS-information);
PS	Programme Service name (R(B)DS-information);
PTY	Programme TYpe (R(B)DS-information);
RDS	Radio Data System;
RBDS	Radio Broadcast Data System;
TA	Traffic Announcement (R(B)DS-information);
TP	Traffic Programme (R(B)DS-information).

AF follow mode	Radio will always be tuned to the Alternative Frequency with the best signal quality.
Traffic station	A station of which the TP (this station) or TA (linked via EON) bit is set to indicate that traffic announcements will be transmitted via this station or linked EON stations.

NOTE: RBDS is an extension of the European RDS system. Every reference in this document to RDS is also valid for the RBDS system unless, otherwise specified.

1.2 References

[1] Outline specification of High-End RDS/EON Car Radio System (CCR612S)
(version 0.2)   AN96043
PCALE, A. Demmers, M. Verheijden.

[2] Specification of the radio data system RDS for VHF/FM sound broadcasting,
European Standard CENELEC   Ref.No. EN 50067

[3] United States RBDS standard January 8, 1993
Specification of the radio broadcast data system,   NRSC

[4] TEA6811/TEA6822 Car Radio Receiver (V 1.2)   AN95074
PCALE, W van Dooremolen.

[5] Improved Dynamic Radio Reception with PACS (TEA6850).   AN95052
PCALE, H de Ruijter.

2   HARDWARE CONFIGURATION

2.1   Block diagram CCR612

Figure 1 shows the block diagram of the high-end computer controlled RDS car radio system CCR612. As can be seen in the block diagram, the system can either be equipped with a fixed keyboard or with a detachable keyboard. The detachable keyboard version of the system still allows some keys to be realised as fixed keyboard keys. Furthermore a choice exists with respect to the following system parts:

- Power amplifier (2 speaker / 4 speaker / output power)
- Sound control (Potentiometer control / I^2C control)

This hardware description only describes the use of the sofac TEA6320.

2.1.1   Main Board Part 1a (Basic AM/FM stereo Radio Part)

Page 81 shows the circuit diagram of the basic radio part, which consist of the following parts: ICE receiver module, audio pre-amplifier, power amplifier, power stabiliser, differential line receiver and PACS control board.

AM/FM - ICE module (TEA6811V,TEA6822T)

The AM/FM - ICE module is a sub-board (see paragraph 2.1.8)which comprises a two IC package (RF IC TEA6811V and IF IC TEA6822T) and is designed especially for use in car radio's. The module contains the following functions;

- AM receiver
- FM receiver
  - FM stereo decoder
  - Interference Absorption Circuit (or Noise Blanker)
  - Station detector and weak signal control
- PLL tuning Synthesizer
- I^2C-Bus control

The complete circuit diagram of the ICE Module (version euro 1) is shown on page 89. For a detailed description of functions and performance see Ref.4.

Audio Pre Amplifier (TEA6320)

I^2C-Bus controlled audio pre-amplifier in SO package for car and home receivers, includes Source selector (for four stereo inputs and one mono input), Loudness characteristic, Volume control, Bass control, Treble control, Balance and Fader control.

Power Amplifier (TDA8561Q)

Car radio power amplifier with dynamic distortion detector and diagnostics in a 17 lead single in line (SIL) plastic power package. It contains 4 x 12W (2 ohm) and 4 x 7W (4 ohm) single-ended or 2 x 24W (4 ohm) bridge amplifiers.

Supply voltage Stabilizer (TDA3602)

Three output voltage regulator, in SIL 9 package, for use in car radios with a microprocessor. It contains two computer controlled voltage regulators with foldback current protection (Regulators 1 and 2) and one fixed voltage regulator (3) that also operates during load dump and thermal shutdown. This regulator is used to supply the microprocessor.
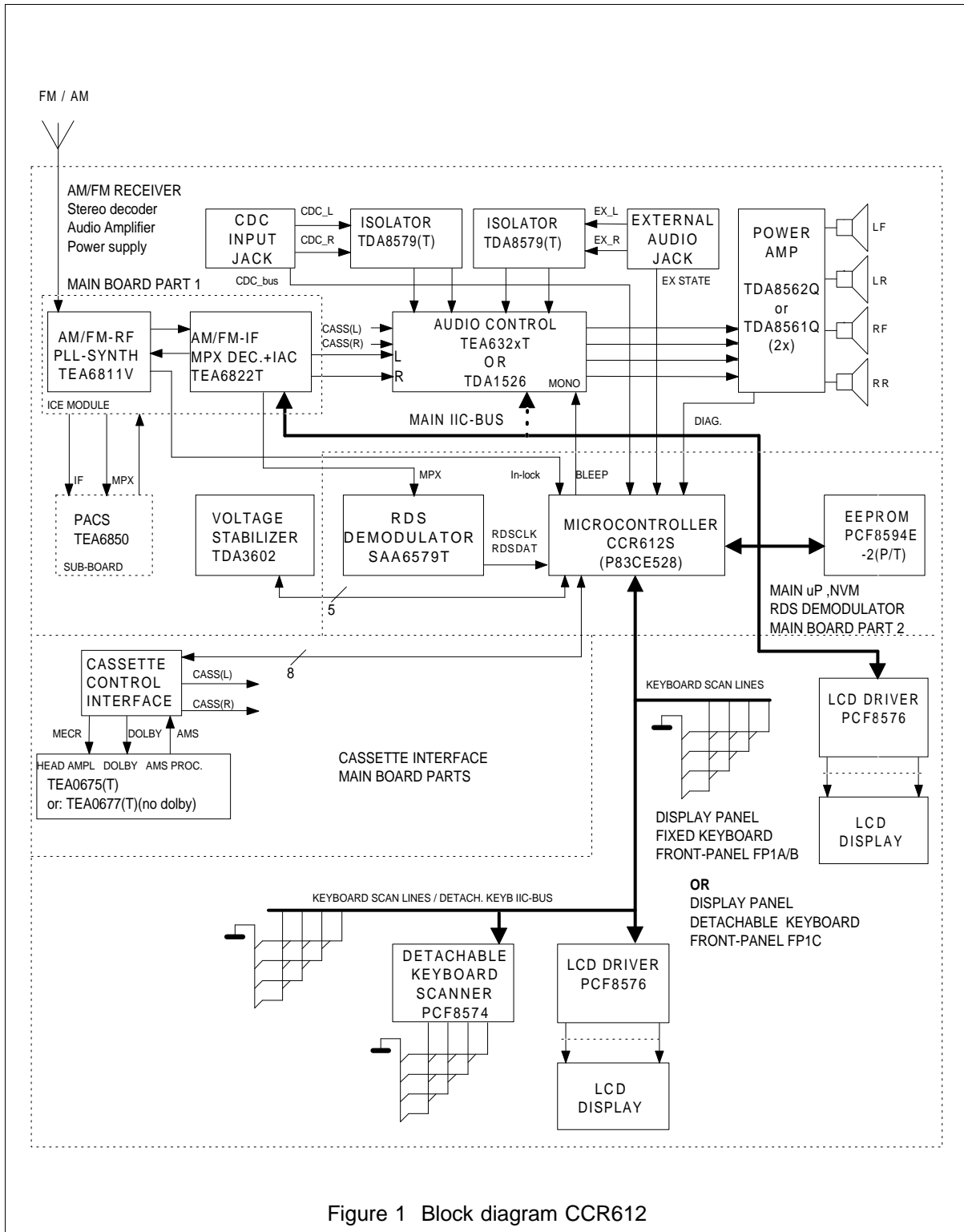
Figure 1 Block diagram CCR612

Isolator (Differential Line Receiver, TDA8579T)

Dual common-mode rejection differential line receiver with 0 dB gain and low distortion. This device is intended to be used to receive line inputs in audio applications that require a high level of common-mode rejection. The device is encapsulated in an 8-pin SO or DIL package. In this set the isolator is used between the external input and source selector input. Both the external input plug circuit and the CD-changer input circuit are equipped with an isolator.

PACS - Sub Board (TEA6850)

PACS controls the I.F. Selectivity / Bandwidth to avoid receiving problems due to near adjacent channels (especially for Europe, spacing of 100 kHz is not an exception). In order to show the improvements of the selectivity and dynamic behaviour of the radio by the use of PACS an ON/OFF switch has been used on the front panel.

A complete circuit diagram of the PACS board is shown on page 94 and for description of the functions, alignment and performance see Ref.5.

2.1.2   Main Board Part 1b (Optional Power Amplifier, 2 x TDA8561Q)

Page 82 shows the previous circuit diagram (paragraph 2.1.1 Basic AM/FM stereo Radio Part) equipped with circuits for 4 x 24W (4 ohm) audio output power.

Power Amplifier (2 x TDA8561Q)

Single circuit configuration 2 x 24W (4 ohm) bridge amplifiers, package SIL 17 pins Quil.

2.1.3   Main Board Part 1c (Optional Source Sel. & Audio Contr. HEF4052B/TDA1526)

Page 83 shows the circuit diagram from paragraph 2.1.1 (Basic AM/FM stereo Radio Part) equipped with the DC controlled audio pre-amplifier (TDA1526) and a source selector circuit (HEF4052B).This set-up is used in case potentiometer control for volume and tone is desired.

Audio Pre-Amplifier and DC Control (TDA1526).

An active stereo,tone/volume control for car radios. It includes functions for bass and treble, control, volume control with built in contour (can be switched off) and balance.All these functions can be controlled direct by DC voltages or via single linear potentiometers.

Source selector circuit (HEF4052B).

The HEF4052B is a dual 4 channel analogue multiplexer/demultiplexer with common channel select logic. In this case used for four stereo inputs: radio, cassette and external input.

2.1.4   Main Board Part 2a (Micro-controller, EEPROM and RDS Demodulator)

Page 84 shows the circuit diagram of the RDS Demodulator, Micro controller (which combines all radio control functions as well as RDS decoding) and EEPROM.

Microcontroller (P83CE528EFB)

Main microcontroller (CCR612S), a derivative of the 8051 micro-controller family with an 8-bit CPU, 32 Kbytes ROM, 512 bytes RAM and four 8-bits I/O ports in a 44-pins QFP package.

EEPROM (PCF8594E-2P/T)

The PCF8594E is a 512 byte, 5V Electrically Erasable Programmable Read Only Memory (EEPROM) that can be 100,000 times re-written. I^{2}C-bus controlled.

RDS Demodulator (SAA6579T)

RDS Demodulator IC, which includes the 57 kHz band-pass-filter, to generate the RDS data out of the MPX signal.

2.1.5   Main Board Part 2b (Detachable Front)

Page 85 shows the previous circuit diagram (paragraph 2.1.4) of the micro controller board extended with the possibility to use a detachable front panel.

2.1.6   Main Board Part 3 (Cassette Interface including Dolby B*)

Page 86 shows the circuit diagram of the cassette interface circuit for the Philips cassette deck P6-29/3. The circuit is based on the TEA0675, Dual Dolby* B-type noise reduction circuit for playback applications.

The TEA0675 includes head and equalization amplifiers with electronically switchable time constants. Furthermore the TEA0675 includes electronically switchable inputs for tape drives with reverse heads. This device also detects pauses of music in the AMS (Automatic Music Search) scan mode.

2.1.7 Front Panels

2.1.7.1 Front Panel Part FP-1a (Key and Display panel)

Page 87 shows the circuit diagram of the key and display panel.

LCD Driver (PCT8576CT)

The PCF8576 is a peripheral device which interfaces to almost any liquid crystal display (LCD) having low multiplex rates. It generates the drive signals for any static or multiplex LCD containing up to four back planes and up to 40/24 segments and can easily be cascaded for larger LCD applications. I^2C-bus controlled.

2.1.7.2 Front Panel Part FP-1b (Detachable Front Version).

Page 88 shows the circuit diagram of the detachable keyboard front. The circuit includes an I/O expander PCF8574, the keyboard and LCD display unit are placed on the detachable front controlled by a second I^2C bus. Eight contacts are required to connect the detachable front to the radio. Furthermore there is a fixed key-board with a limited number of keys included. That means it is possible to use a combination of detachable keys and fixed keys (for circuit example see page 85).

2.1.8 Diagram ICE module.

Standard Version EURO 1

Page 89 shows the complete circuit diagram of the ICE AM/FM tuner module version Euro 1.
The Standard Euro 1 module is intended for European frequency ranges.

FM	87.5	to	108.0 MHz
AM (MW)	531	to	1629 kHz
AM (LW)	144	to	288 kHz

The module contains the IC's TEA6811V and TEA6822T with the following main functions;

TEA6811		TEA6822	
	- AM RF		- 2nd AM mixer
	- AM mixer		- 2nd FM mixer
	- FM mixer		- AM/FM - IF amplifier
	- AM/FM oscillator		- AM and FM demodulator
	- Tuning synthesizer		- x-tal oscillator (61.5 MHz)
	- I^2C-Bus		- Stereo Decoder and IAC
			- Station (stop) detector
			- Weak signal processing
			- Multi Path Detector
			- I^2C-Bus

EURO 2, USA 1 and JAPAN 1 ICE MODULE VERSIONS.

By slight circuit modifications of the standard module (EURO 1), matched module versions with better performance for e.g. USA an Japan can be derived. The needed modifications for the different modules are:

Module Version	Modifications.
Euro 1	Non
Euro 2 (including S.W.)	A short wave transformer i.s.o. L8 and C29
USA 1	L15 short circuited
	C2 10pF i.s.o. 5p6
	C72 6p8 deleted
	R18 1 Mohm i.s.o. 220 Kohm
	R54, in parallel with C26 (1uF)
	C61 10 nF i.s.o. 6n8
	C62 10 nF i.s.o. 6n8
	Z1 SFR450H i.s.o. SFP 450H
	Z3 SFE 10.7 MS3 G-A 220 kHz i.s.o. SFE10.7 MS3 A 10k-A
	Z2 & Z4 SFE 10.7 MS2 G-A 180 kHz i.s.o. SFE10.7 MS3 A 10k-A
	R41 (pre-set adjust) replaced by resistor of 68 Kohm.
	R44 120 Kohm i.s.o. 82 Kohm.
Japan 1	C7 47 pF i.s.o. 180pF
	C9 deleted
	D3 BB814 selection i.s.o. BB804

2.1.9   Diagram PACS Sub Board

Page 94 shows the diagram of the PACS Sub-Board using the TEA6850. For circuit description, performance and PCB lay out see application note Ref.5.

2.1.10   PCB LAY-OUTS of CCR612 sample Version D.

CCR612/Mainboard PCB lay-out TOP side Copper (p. 90, fig. a) / Components (non SMD) (p. 90, fig. b)
CCR612/Mainboard PCB lay-out BOTTOM side Copper(p. 91, fig. c) / SMD Components (p. 91, fig.d)
ICE module board PCB lay-out TOP side Copper(p. 92, fig. a) /Components (non SMD) (p. 92, fig. b)
ICE module board PCB lay-out Bottom side Copper(p. 92, fig. c) / SMD Components (p. 92, fig. d)
Front panel PCB lay-out Top side Copper (p. 93, fig. a) / Components (non SMD) (p. 93, fig. b)
Front panel PCB lay-out Bottom side Copper (p. 93, fig. c) / SMD Components (p. 93, fig. d).

2.2   Performance of the radio

<u>General</u>

Supply voltage range		10.2	to	16	V
Quiescent current:	power off		<	2	mA (typ.)
	power on			550	mA (typ.)
Operating ambient temperature		-30	to	80	°C
FM frequency range:	Europe	87.5	to	108.0	MHz
	USA	87.9	to	107.9	MHz
AM frequency range:	Europe	144	to	288	kHz (LW)
		531	to	1629	kHz (MW)
		5900	to	6200	kHz (SW)
	USA	530	to	1710	kHz (MW)
		5900	to	6200	kHz (SW)
IF-frequency double conversion:	FM-IF1/IF2	72.2 MHz / 10.7 MHz			
	AM-IF1/IF2	10.7 MHz / 450 kHz			

FM characteristics

V_{supply} = 14.4 V, T_{amb} = 25 °C, f_o = 98 MHz, f_{dev} = ±22.5 kHz, f_{mod} = 1 kHz unless otherwise specified. Dummy aerial as shown in Figure 2.

Figure 2 Dummy aerial to test the FM mode
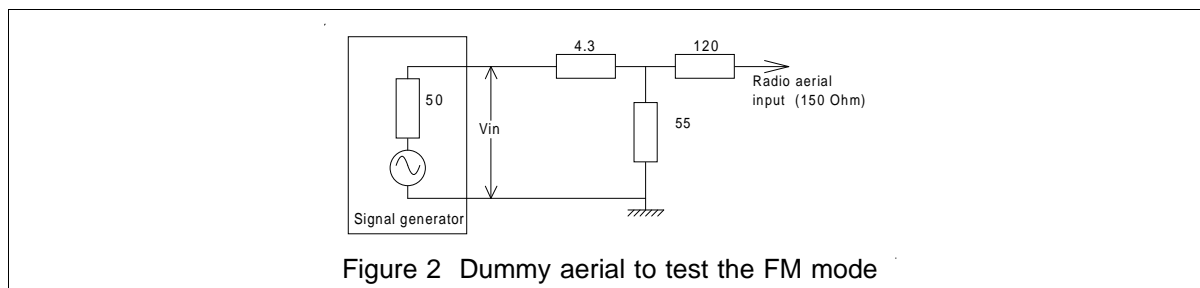
Aerial input voltage (Vin), for -3 dB limiting (adjustable)		3 - 20	μV
for (S+N)/N = 26 dB		2.7	μV
for 10 dB crosstalk (stereo)		70	μV
Signal-to-noise ratio over most of the signal range		64	dB
RF signal handling capability for THD < 2% at 75kHz dev.	>	2	V
MPX output (RMS value) at pin 47 of the TEA6822		200	mV
AM suppression over most of the signal range	>	55	dB
Total Harmonic Distortion over most of the signal range. 75 kHz dev.		0.5	% (typ.)

Adjacent signal selectivity (two signal method) S_{200}			>	45	dB
IF suppression:	IF1 (72.2 MHz)		>	70	dB
	IF2 (10.7 MHz)		>	90	dB
Search sensitivity (adjustable)		Vin	>	4	μV
RDS sensitivity:	Traffic Announcement	Vin	>	12	μV
	Programme Identification	Vin	>	15	μV
IF counter resolution				6.25	kHz
Frequency grid (Europe):	Search Tuning			100	kHz
	Manual Tuning			50	kHz
	Repetitive Manual tuning (after .5s)			100	kHz
Frequency grid (USA):	Search Tuning			200	kHz
	Manual Tuning			100	kHz
	Repetitive Manual tuning (after .5s)			200	kHz

<u>AM characteristics</u>

V_{supply} = 14.4 V, T_{amb} = 25 $^\circ$C, f_o = 999 kHz, m = 0.3, f_{mod} = 1 kHz unless otherwise specified. Dummy aerial as shown in Figure 3.

Figure 3 Dummy aerial to test the AM mode
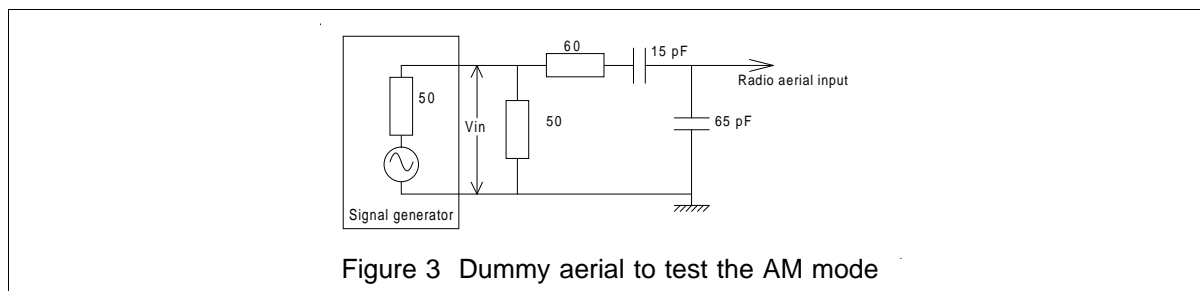
Aerial input voltage (Vin),			
for (S+N)/N = 26 dB	MW	55	μV
	LW	80	μV
	SW	t.b.f.	
Signal-to-noise ratio for Vin = 1 mV		> 55	dB
AGC range 5 mV/Vin for 10 dB variation of AF output		> 60	dB
RF signal handling capability for THD < 10 % at m = 0.8		> 3	V
Total Harmonic Distortion over most of the			
AGC range, m = 0.8, fmod = 1 kHz		< 2	%
Total bandwidth B 3dB		4.5	kHz
Fidelity (-3 dB)		10 Hz - 2 kHz	
IF suppression IF1 (10.7 MHz)		> 70	dB
IF2 (450 KHz)		> 100	dB
IF selectivity S_9		> 55	dB
S_{18}		> 60	dB
IF counter resolution		250	Hz

Frequency grid   Europe

LW (search and manual tuning)	1	kHz
MW (search and manual tuning)	9	kHz
SW (search and manual tuning)	1	kHz

USA

MW (search and manual tuning)	10	kHz
SW (search and manual tuning)	1	kHz

Search sensitivity (adjustable)	> 20	μV

3 SHORT SPECIFICATION

Tuning

- Frequency bands:
  Optionally the following frequency bands are used:

FM:	87.50	-	108.00	MHz (50 / 100 kHz steps)	}
MW:	531	-	1629	kHz (9 kHz steps)	} For application in Europe
LW:	144	-	288	kHz (1 kHz steps)	}
SW:	5.9	-	6.2	MHz (1 kHz steps)	}

FM:	87.90	-	107.90	MHz (100 / 200 kHz steps)	}
MW:	530	-	1710	kHz (10 kHz steps)	} For application in USA
SW:	5.9	-	6.2	MHz (1 kHz steps)	}

- PLL tuning principle

- Manual tuning up / down
  First one step, next after 0.5 seconds. Fast repetition at 12.5 times per second.

- Local/Dx switching
  The Local/Dx feature controls the search sensitivity. Default after switching on is always Dx.
  In the TEA6811 a tuner attenuator for the FM-band is incorporated.

- Search tuning up / down
  Sensitivity is controlled by Local/Dx. If after one complete band sweep in Local mode no station is found, the radio switches automatically to Dx. During search tuning the running frequency is displayed and the radio is muted.

- Frequency Scan
  Continuous automatic search tuning, pausing for 6 seconds on every station.

- AST (Automatic Store Tuning) for FM and MW band
  AST switches to FM-AST or MW-AST band, searches for the 6 strongest transmitters in the band and stores them in the AST programme preset memory. In FM, duplication of PI codes will be avoided.

- Programme preset memory
  For each band (FM1, FM2, MW, LW, SW (49m), FM-AST and MW-AST) 6 programme presets and a "manual" frequency are stored. In FM, additional RDS information is stored: PI code (Programme Identification), PS name (Programme Service), AF list (Alternative Frequencies) and AF follow mode on/off.
  Whenever another band is selected, the radio reverts to the last frequency tuned to in the new band (this can be either a preset frequency or a manually tuned frequency).

- Programme preset up / down control
  Programme presets can be stored and recalled by two key control (up and down) or by 6 separate preset keys.

- AF follow mode
  When AF follow mode is on, the set will regularly measure the signal strength of alternative frequencies and compare it with the current station. If an alternative frequency offers better quality, the radio will switch over and update the alternative frequency list. The measuring scheme is designed to cause minimum noticeable disturbance for the listener. The interval time between two measurements depends on the signal quality.

- Intelligent preset programme recall
  If an FM programme preset with a known PI code is recalled, the primary frequency and all alternative frequencies stored in the programme preset memory are examined. The frequency with the best signal quality broadcasting the correct PI code will be selected. Only when the programme is not found on one of the AFs, after 6 seconds a search is started for a station with a proper PI code.

- TA mode
  In TA mode the radio only searches for transmitters that transmit the RDS traffic programme on the same station or on EON linked stations. The radio will automatically start a search when switching TA mode on and the current station is not a traffic station.

- PTY scan mode
  In PTY scan mode the radio searches for transmitters that transmit the user-selected PTY code. Dependent on the factory option USA/Europe the RBDS PTY-table or the RDS PTY-table is used. Only English PTY messages are available.

- Last status memory: band, frequency, PI code, AF follow mode on/off status and TA mode on/off status are stored in memory. This status is recalled during switch on.

RDS

- Bit, block and group synchronisation. (inclusive RBDS E-block detection).

- Data collection and decoding of:
  - PI,   Programme Identification code
  - AF,   Alternative Frequencies
  - TP,   Traffic Programme
  - TA,   Traffic Announcement
  - PS,   Programme Service name
  - PTY,   Programme TYpe
  - EON,   Enhanced Other Network

- AF follow mode using PI and AF (see also Tuning).

- Display of the programme service name in 8 alpha-numeric characters (PS name).

- Display of AF, TP, TA, PTY, EON and Regional mode status via icons.

- Regional mode on/off switching. When Regional mode is on, the radio will, during AF switching, only switch over to stations with exactly the same PI-code. When Regional mode is off, the radio will also

switch over to stations broadcasting regional variants of the original station. (so called "generic" or "family" PI codes). For USA application (RBDS) the regional function will only work for PI codes above B000$_{hex}$. PI codes below B000$_{hex}$ do not have regional variants. Af switching is only allowed to stations with exactly the same PI code.

- Break-in of traffic announcements is possible if the TA option is switched on. The PTY alarm messages break-in always. Break in is possible even when the radio is muted or in CD-changer / cassette / external mode.

User Control

- Up to 27 Local control keys on either a fixed, a detachable keyboard or a combination. Triangular matrix using 7 lines.

- Detachable front
  Optionally, the keyboard and the LCD display unit can be placed on a detachable front controlled by a 2nd I^{2}C bus. Only 5 contacts are required to connect the detachable front (6 if it hosts also the power key). No extra hardware is required to detect its presence.

EON

- If the TA option is on, switch temporarily to an other station if EON information indicates a traffic announcement on another network even when the radio is muted or in CD-changer / cassette / external mode.

- Maintain lists of alternative frequencies of other stations stored in preset memory with information received via EON on the currently tuned station.

- Display by means of an icon whether EON data is received and whether an EON traffic announcement is broadcast.

Display

- 143 Segment LCD with Umlaut (ü) characters, 1:4 multiplexed divided into:

- 8 Alphanumeric characters + decimal point are used to display:
  - Band and frequency (Example: "FM 103.50")
  - Indication "BALANCE", "FADER", "TREBLE", "BASS" and their value.
  - RDS programme service name (PS) in 8 alphanumeric characters.
  - RDS programme type (PTY)
  - "MUTE", in case the user mutes the radio, cassette or external
  - Cassette mode function such as "PLAY >", "CAS WIND", etc.
  - CD-changer messages such as "CD 01.23" , "CHANGER " etc.

- 7 Segment display for the current programme preset number.

- 15 Icons for display of:
  - ST   On when stereo pilot signal is detected and the radio is not in forced mono mode.
  - AST   On when AST band is selected.
  - SCAN   On when in Frequency scan mode.
  - AF   On when AF follow mode is enabled (see also Tuning), flashing if no RDS data received.
  - TA   On in TA mode and flashing during a traffic announcement in progress.
  - TP   On when a traffic station is received, flashing when the station is not a traffic station and TA mode is on.
  - PTY   On when a PTY code is received, flashing during PTY search.
  - DOLBY ⅅⅅ   On in cassette mode when dolby is on.
  - MTL   On in cassette mode when metal/chrome is selected.
  - AMS   On in cassette mode when AMS is on.
  - REG   On when the radio is in regional mode (see also RDS)
  - EON   On when EON data is received, flashing during an EON traffic announcement.
  - LOC   On when the radio is in Local mode (see also Tuning)
  - LOUD   On when Loudness is on.
  - CLIP   On when clipping is detected and clipping control is active.

Non Volatile Memory

512 bytes EEPROM. The following information is stored in NVM:

- System status e.g.: band, audio source (radio / CD-changer / cassette / external).
- For each band FM1, FM2, FM-AST, MW, MW-AST, LW, SW(49m) : 6 preset frequencies, one non-preset frequency and the last used preset number.
- For each FM preset:
  - PI-code
  - PS Name
  - AF List (9 AF's)
  - AF follow mode on/off.
- Audio controls: volume, bass, treble, balance, fader and loudness.
- Preprogramming EEPROM
- At power-on the contents of the NVM is checked, when a non-initialized EEPROM is detected, the EEPROM will be preprogrammed with default values.
  Appendix II lists the default values written to NVM during initialization.

Sound

- Volume, bass, treble, balance and fader control with VOL-UP / VOL-DOWN keys.
- Analog control select key to cycle through bass, treble, balance and fader.
- Mute function.
- Automatic muting during tuning and AST search (silent tuning).
- Break-in of traffic announcements and PTY-alarm messages (at increased volume level, which is user programmable) when the radio is muted or in cassette / external mode.
- Loudness function.

- Sound settings are stored at switch-off and recalled at switch-on.
- "Bleep" tone to confirm user actions such as storing a programme preset, entering AST mode, etc.
- Mono / stereo function.
- Output pins for mute, loudness and traffic announcement, for use with conventional audio control circuitry.
- Automatic mute of radio during "Phone mute" detection.

Power-amplifier
- Power-amplifiers with diagnostic facilities
  * $1 \times$ TDA8561Q amplifier for 4×12 W (2Ω load) or 4×7 W or 2×24 W bridged application. (both at 4Ω load)
  * $1 \times$ TDA8562Q amplifier for 4×12 W (2Ω load) or 4×7 W (4Ω load)
  * $2 \times$ TDA8561Q amplifier for 4×24 W bridged application. (4Ω load)
- Diagnostic control:
  * short-circuit or too high temperature detection, display an error message
  * signal clipping, via an icon and stepwise decrease of bass and or volume
- Optional conventional power-amplifiers (without diagnostics) can be used such as two TDA1552Q for 4×22 W, one TDA1554Q for 4×11 W (2Ω load) or 4×6 W (4Ω load) or one TDA1552Q 2×22 W in a BTL stereo configuration.

Options
- Diode programmable
  - Detachable front
  - Available frequency bands
  - Static on/off switch
  - Frequency band limits and tuning grid for different parts of the world. This option also selects between RDS (Europe) and RBDS (USA).

- User programmable
  - 2 / 4 Loudspeakers
  - Loudness on / off
  - TA volume level

- Automatically detected
  - Digital sound control chip or conventional audio control circuitry
  - Loudness
  - AMS   }
  - Dolby   } Cassette deck functions
  - MTL   }
  - Presence of the CD-changer (check during power-on)
  - Availability of a power amplifier with diagnostics facilities

Power connections
- Continuous power supply input. Normally connected directly to the car battery. All supply power is drawn from this supply.
- Ignition key input. Normally connected to the accessory contact of the ignition switch. Used only for switching the radio on/off. This input is also used when the static on/off switch option is chosen instead of the momentary on/off key.

Switching on/off
- Recall of last system status (e.g.: frequency, band, sound control settings, RDS status and last selected audio source).
- Switch on by:
  - Power key, can be static or momentary.
  - Ignition contact (after the set was switched off by turning the ignition contact off).
- Switch off by:
  - Power key, can be static or momentary.
  - Ignition contact.
  - Removal of detachable keyboard.
- When switched on while the ignition contact is (and remains) off, the set will automatically switch off after 60 minutes.
- The radio will switch on again when switched off due to a power dip during engine start.

CD-changer
- Radio/CD-changer/Cassette/External mode key.
- Disc up/down keys for selecting the next/previous disc.
- Track up/down keys for selecting the next/previous track.
- Fast forward/reverse keys for jumping some grooves forward/backward.
- Shuffle on/off key, for playing the tracks in random order. (The user can make a selection between tracks on the current disc only or tracks on all discs.)
- Repeat on/off key, for repetitive play of the current track or the current disc.
- Intro-scan key. When Intro-scan mode is on, each track of the current disc or the first track of every disc (user selectable) are played for 10 seconds in successive order.

Cassette

- Automatically switches to cassette mode after insertion of a tape
- Interfaces with a mechanically controlled cassette deck
- Play/wind mode detection
- Play direction detection for auto-reverse cassette decks
- Cassette solenoid control
- AMS pause detection for full AMS control
- Radio sound during cassette winding
- MTL on/off key
- DOLBY on/off key
- AMS on/off key
- CD-changer/Cassette/Radio/External mode key
- Optional source switching to external mode (external plug is in) or always to radio mode (option diode D6 is present) when the tape is ejected.

External audio input:

- Automatically switches to external audio source when a connector is inserted.
- CD-changer/External/radio/Cassette mode key.
- Optional source switching to cassette mode (tape is in) or always to radio mode (option diode D6 is present) when the external plug is removed.

4 CCR612S PINNING AND INTERFACING

CCR612S is accommodated in a P83CE528 microcontroller in a 44-pins Quad Flat Package. It is manufactured in CMOS technology and is a derivative of the 80C51 microcontroller family. It contains 32 kbytes of ROM and 512 bytes of RAM.

For electrical characteristics of I/O pins, see the P83CE528 data sheet.

4.1   Pinning overview

When the radio is equipped with a detachable keyboard, pins KEYB5_FSDA & KEYB6_FSCL (pins 23 & 24) are used as I^{2}C-bus lines to the detachable keyboard. Otherwise pin 23 and pin 24 are used as scan lines for the fixed keyboard.
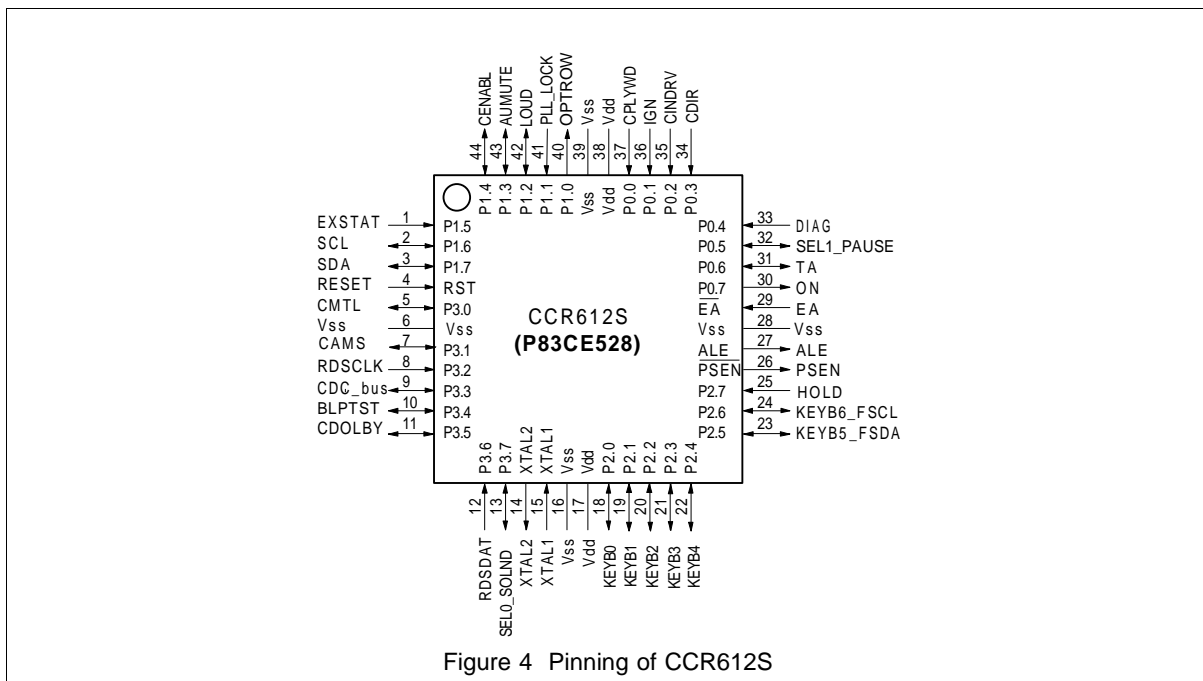

Figure 4 Pinning of CCR612S

In case of conventional audio sound control circuitry, pin SEL0_SOLND and SEL1_PAUSE are used to select between the various audio sources (radio, CD-changer, cassette, external output) by means of a dual 4 channel analogue multiplexer (e.g. HEF4052B). If a TEA632x is installed these pins can be used for respectively solenoid control and AMS pause input control.

The next tables give a description of the function of all pins.

Legend for pin types:
OD	Open Drain
IP	Internal Pull up resistor
1	Can sink 1 TTL load (or 4 LSTTL)
2	Can sink 2 TTL loads (or 8 LSTTL)

Pinning CCR612S

Pin	Name	I/O	Type	Description
1	EXSTAT	I	IP 1	Indicates whether external audio source is connected. High: external audio source is not connected Low: external audio source is connected
2	SCL	I/O	OD 2	Clock line of I^{2}C bus
3	SDA	I/O	OD 2	Data line of I^{2}C bus
4	RESET	I		Normally low. To start the microcontroller, a high pulse of at least 20 milliseconds must be applied to this pin. A reset pulse must be applied when: - Power is applied to the radio - The power key is pressed while the radio is off - The ignition contact is switched on while the radio is off The reset input is normally connected to the reset and hold outputs of the power stabiliser TDA3602, via a capacitor and a diode.
5	CMTL	O	IP 1	Cassette Metal (versus Chrome/Ferro) mode High: Ferro/Chrome selected Low: Metal selected
		I		If the cassette deck does not have this function, the pin must be connected to Vdd.
6	Vss			Ground
7	CAMS	O	IP 1	Automatic Music Search High: AMS is active Low: AMS is inactive
		I		If the cassette deck does not have this function, the pin must be connected to ground.

Pinning CCR612S

Pin	Name	I/O	Type	Description
8	RDSCLK	I	IP 1	RDS Clock line. Connected to clock output pin of RDS demodulator SAA6579
9	CDC_bus	I	IP 1	CD-changer bus. The CDC_bus is a bi-directional bus which allows the CD-changer and the radio to exchange commands and status information.
10	BLPTST	O I	IP 1	1. Bleep tone output signal. Normally high. This pin outputs the bleep tones. 2. When pulled low externally, service mode is entered. The microcontroller stops all I^{2}C bus transfers after completion of the last user action (within 0.5 sec. except for search tuning). This feature can be used for factory testing and programming the NVM before the radio leaves the factory.
11	CDOLBY	O I	IP 1	Cassette Dolby mode High: Dolby not selected Low: Dolby selected If the cassette deck does not have this function, the pin must be connected to Vdd.
12	RDSDAT	I	IP 1	RDS Data line. Connected to data output pin of RDS demodulator SAA6579.
13	SEL0_ SOLENOID	O O I	IP 1	SEL0 (no TEA632x installed). Source selection Sel1 Sel0 0 0 CD-changer source selected 0 1 Cassette source selected 1 0 External source selected 1 1 Radio source selected SOLENOID (TEA632x installed). Cassette solenoid High: Solenoid in standby position Low: Solenoid is locked If the cassette deck does not have this function, the pin must be connected to ground.
14 15	XTAL2 XTAL1	O I		A 12 MHz crystal is connected between these pins, controlling the internal clock oscillator. When an external clock is used, it must be applied to XTAL1.
16	Vss			Ground
17	Vdd			Power supply: + 5V
18-24			IP 1	Keyboard scan lines. Pin assignments are different for fixed front and detachable front. See relevant tables at the end of this section.

Pinning CCR612S

Pin	Name	I/O	Type	Description
25	HOLD	I	IP 1	Connected to the hold output pin of the voltage stabilizer TDA3602. This pin is used to check for power failures.
26	/PSEN	O		Program Store Enable output, used when the microcontroller runs code from an external memory. Not used by the CCR612S system. The pin will always be high.
27	ALE	O		Address Latch Enable output, used when the microcontroller accesses external memory. Not used by the CCR612S system. This pin should not be connected. In the EMC improved microprocessors (P83CE528) this pin is muted.
28	Vss			Ground
29	/EA	I		External Access input. Should be held high (with a pull-up resistor) to ensure that the microcontroller runs from internal program memory (ROM).
30	ON	O	OD 2	Controls the voltage stabiliser TDA3602 High: Switch supply voltages off (TDA3602 in "coma" state) Low: Switch supply voltages on (TDA3602 in "on" state)
31	TA	O	OD 2	Traffic Announcement indication High: No traffic announcement Low: Traffic announcement or PTY alarm message in progress This pin can be used to raise the volume setting during traffic announcements and PTY alarm messages in case no digital sound control IC is used.
		I		Option diode for static on/off switch detection.

Pinning CCR612S

Pin	Name	I/O	Type	Description
32	SEL1_ PAUSE	O	OD 2	SEL1 (no TEA632x installed). Source selection Sel1 Sel0 0 0 CD-changer source selected 0 1 Cassette source selected 1 0 External source selected 1 1 Radio source selected
		I		PAUSE (TEA632x installed). Cassette AMS pause High: No pause detected Low: Pause detected If the cassette deck does not have this function, the pin must be connected to ground.
33	DIAG	I	OD 2	Power amplifiers diagnostics input. High: Normal mode Low: Clipping, overheated or shortcircuit.
		I		If no diagnostics facilities are available this pin should be connect to Vdd.
34	CDIR	I	OD 2	Indicates the play direction of the cassette deck. Used to show the play direction on the display High: Reverse (<- arrow displayed) Low: Forward (-> arrow displayed)
35	CINDRV	I	OD 2	Indicates whether a tape is in the cassette drive. Used to switch to cassette mode when a tape is inserted. High: No tape in drive Low: Tape in drive
36	IGN	I	OD 2	Indicates status of ignition contact or the static on/off switch (when this option is chosen). Used to switch the set on or off. High: Ignition contact / static switch on Low: Ignition contact / static switch off
37	CPLYWD	I	OD 2	Indicates play/wind status of cassette deck. Used to switch to radio reception during winding. High: Wind Low: Play
38	Vdd			Power supply: + 5V

Pinning CCR612S

Pin	Name	I/O	Type	Description
39	Vss			Ground
40	OPTROW	O	IP 1	Connected to the cathodes of all option diodes. During switch on, this pin is pulled low by the microcontroller to find out which option diodes are present.
41	PLL_LOCK	I	IP 1	PLL In Lock detection. High: Tuner is in lock. Low: Tuner is not in lock.
42	LOUD	O	IP 1	Loudness control. This pin can be used to switch loudness on/off in case no digital sound control IC is used. High: Loudness off Low: Loudness on
		I		loudness control is not available when this pin is connected to ground.
43	AUMUTE	O	IP 1	General mute control. This pin can be used to control general audio muting in case no sound control IC is used. High: Not muted Low: Muted
		I		Phone mute input High: No phone mute request Low: Phone mute request
		I		Option diode available bands 1
44	CENABL	O	IP 1	Cassette Enable. Controls the cassette deck motor. High: Cassette motor off Low: Cassette motor on
		I		Option diode for detachable keyboard detection.

Pins 18 to 24 of CCR612 with fixed front.

Pin	Name	I/O	Type	Description
18	KEYB0	I/O	IP 1	Line of the triangular keyboard matrix
19	KEYB1	I/O	IP 1	Line of the triangular keyboard matrix
20	KEYB2	I/O I	IP 1	Line of the triangular keyboard matrix Option diode for tuning grid and band limits (USA / Europe option)
21	KEYB3	I/O I	IP 1	Line of the triangular keyboard matrix Option diode for available bands.
22	KEYB4	I/O	IP 1	Line of the triangular keyboard matrix
23	KEYB5	I/O	IP 1	Line of the triangular keyboard matrix
24	KEYB6	I/O	IP 1	Line of the triangular keyboard matrix

The fixed keyboard (See Figure 6) is scanned every 10 milliseconds. To scan the keyboard, the lines are made low - one at a time - and then the state of the other lines are read. For debouncing, a keypress must be detected 3 times before it is accepted.

Pins 18-24 of CCR612 with detachable front

Pin	Name	I/O	Type	Description
18	KEYB0	I/O	IP 1	Line of the triangular keyboard matrix
19	KEYB1	I/O	IP 1	Line of the triangular keyboard matrix
20	KEYB2	I/O I	IP 1	Line of the triangular keyboard matrix Option diode for tuning grid and band limits (USA / Europe option)
21	KEYB3	I/O I	IP 1	Line of the triangular keyboard matrix Option diode for available bands.
22	KEYB4	I/O	IP 1	Line of the triangular keyboard matrix These lines form a small extra triangular keyboard matrix. (See Figure 7). This keyboard is scanned every 10 milliseconds. To scan the keyboard, the lines are made low - one at a time - and then the state of the other lines are read. For debouncing, a keypress must be detected 3 times before it is accepted. This keyboard can be used optional together with the detachable keyboard. The power key should always be available in this keyboard but not when the static on/off switch option is used.
23	SDA_ FRONT	I/O	IP 1	Data line of front panel I^2C bus. The detachable front has a separate I^2C bus, for which measures may be taken to reduce interference and to improve immunity for static charges. It also isolates radio circuitry from the externally accessible contacts. The front panel I^2C bus controls the display driver and the 8-bit bi-directional I/O expander to which the keyboard matrix is detected.
24	SCL_ FRONT	I/O	IP 1	Clock line of front panel I^2C bus.

4.2   Factory options

4.2.1   Diode options

The following options can be selected by means of option diodes:

| Diode	Pin	Description		
D1	44	Detachable keyboard is available. (diode present)		
D2/D3	21/43	Diode D2	Diode D3	Available bands
		Not present	Not Present	FM, MW, LW
		Present	Not Present	FM
		Not present	Present	FM, MW
		Present	Present	FM, MW, LW, SW(49m)
D4		No used in CCR612S		
D5	31	Static on/off switch. (diode present)		
D6		Not used in CCR612S		
D7	20	Tuning grid and band limits for USA application are selected (diode present). LW band is disabled and the RBDS PTY code table is selected.		
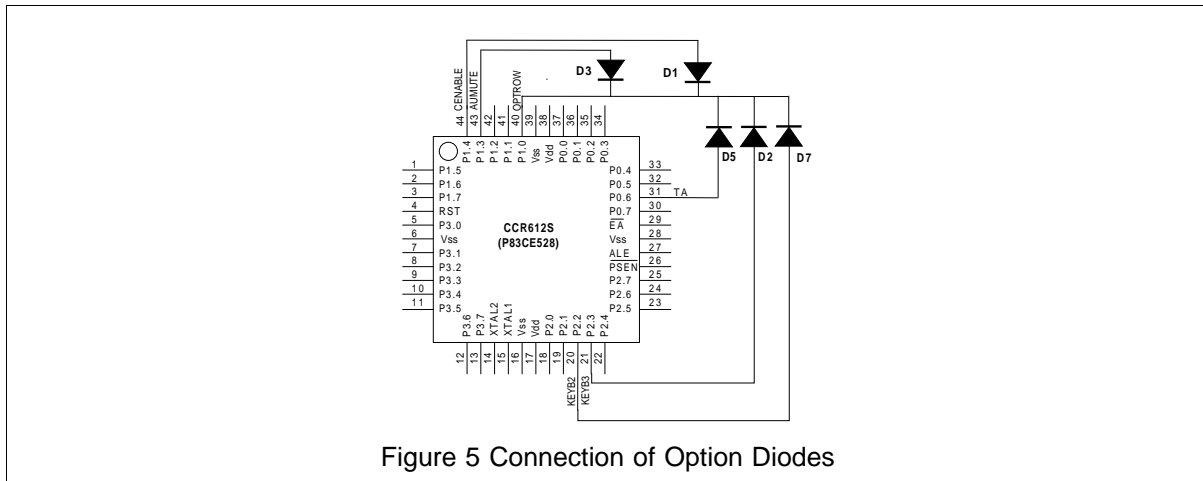
Figure 5 Connection of Option Diodes

4.2.2 Automatically detected options

CCR612S will detect the following options automatically:

- Digital sound control chip.
  Presence / absence of a sound control chip (TEA632x) is detected by testing its I^{2}C bus address.
  NOTE: The output pins AUMUTE, LOUDN and TA are always operational, even when a digital sound control chip is installed. Cassette solenoid and AMS pause control functions are not available in case no TEA632x is installed.

- AMS   }
  DOLBY   }   These functions are not available if the corresponding
  MTL   }   output pin is connected to Vdd except for pins CAMS
  LOUDNESS   }   and LOUD which must be connected to ground.
  DIAGNOSTICS }

- Presence of the CD-changer (check during power-on)

4.3 I^{2}C bus addresses

CCR612 I^{2}C bus peripherals will be accessed at the following addresses:

    C4 h PLL synthesizer TEA6811V
    C2 h IF system TEA6822T
    80 h Sound control circuit TEA632x
    A0 h NVM PCF8594
         (The PCF8594 responds automatically to address A2 h for access to its upper half);
    40 h I/O expander PCF8574
   70 h Display driver PCF8576

4.4 The keyboard

Two different configurations are possible:

1. A fixed keyboard, directly connected to the microcontroller.

2. A detachable keyboard, using an I/O expander to connect to the microcontroller via a dedicated I^{2}C bus. A fixed keyboard with a limited number of keys still remains possible.

4.4.1   Fixed keyboard

The fixed keyboard is scanned every 10 milliseconds. For debouncing, the same situation must be detected 3 times before it is accepted.

Figure 6 Fixed keyboard
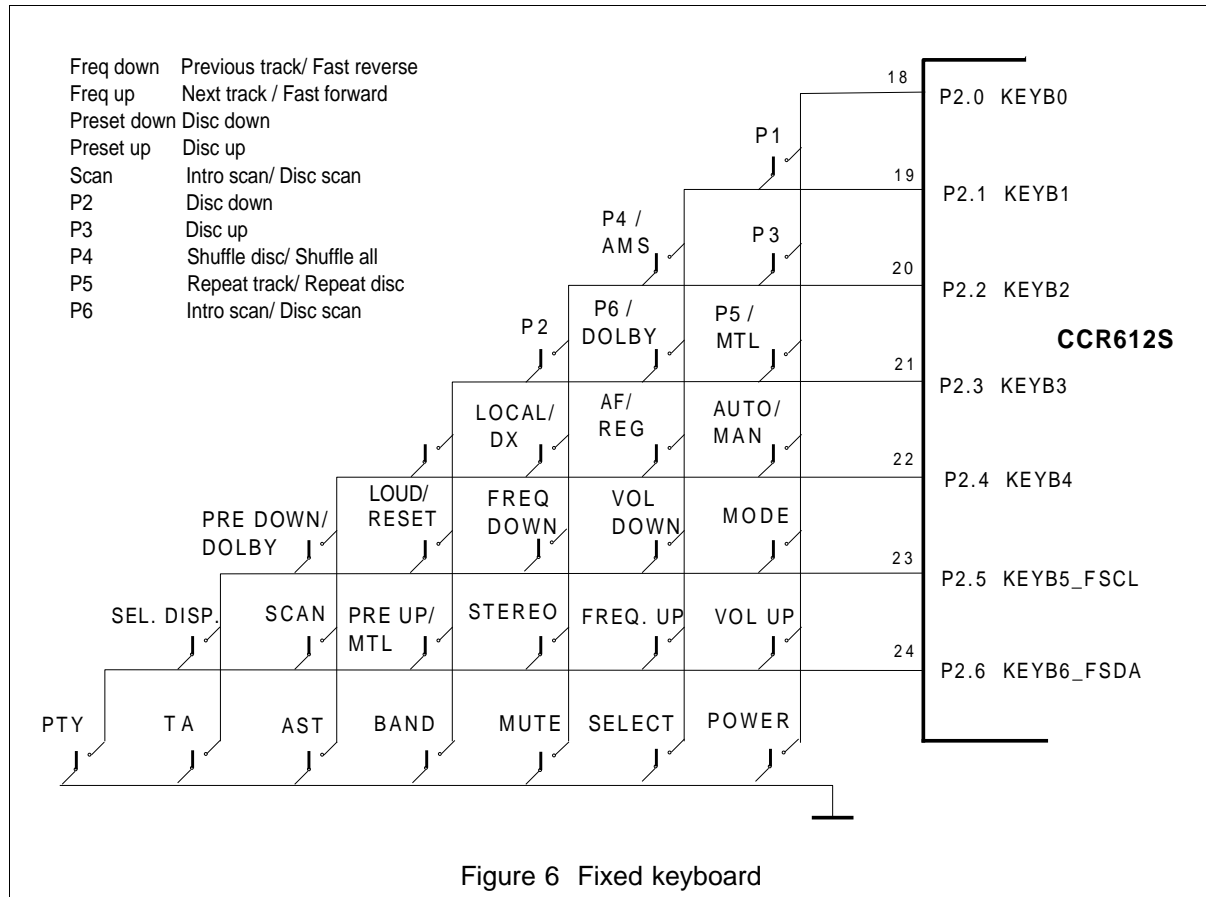
4.4.2   Detachable keyboard

The detachable keyboard is scanned every 20 milliseconds (10 msec. for the small fixed keyboard). For debouncing, the same situation must be detected 2 times (3 times for the small fixed keyboard) before it is accepted.

The microcontroller will automatically detect that the detachable front is removed, and will switch the radio off. Placing the front on the radio does not cause the radio to switch on.

Figure 7 Detachable keyboard
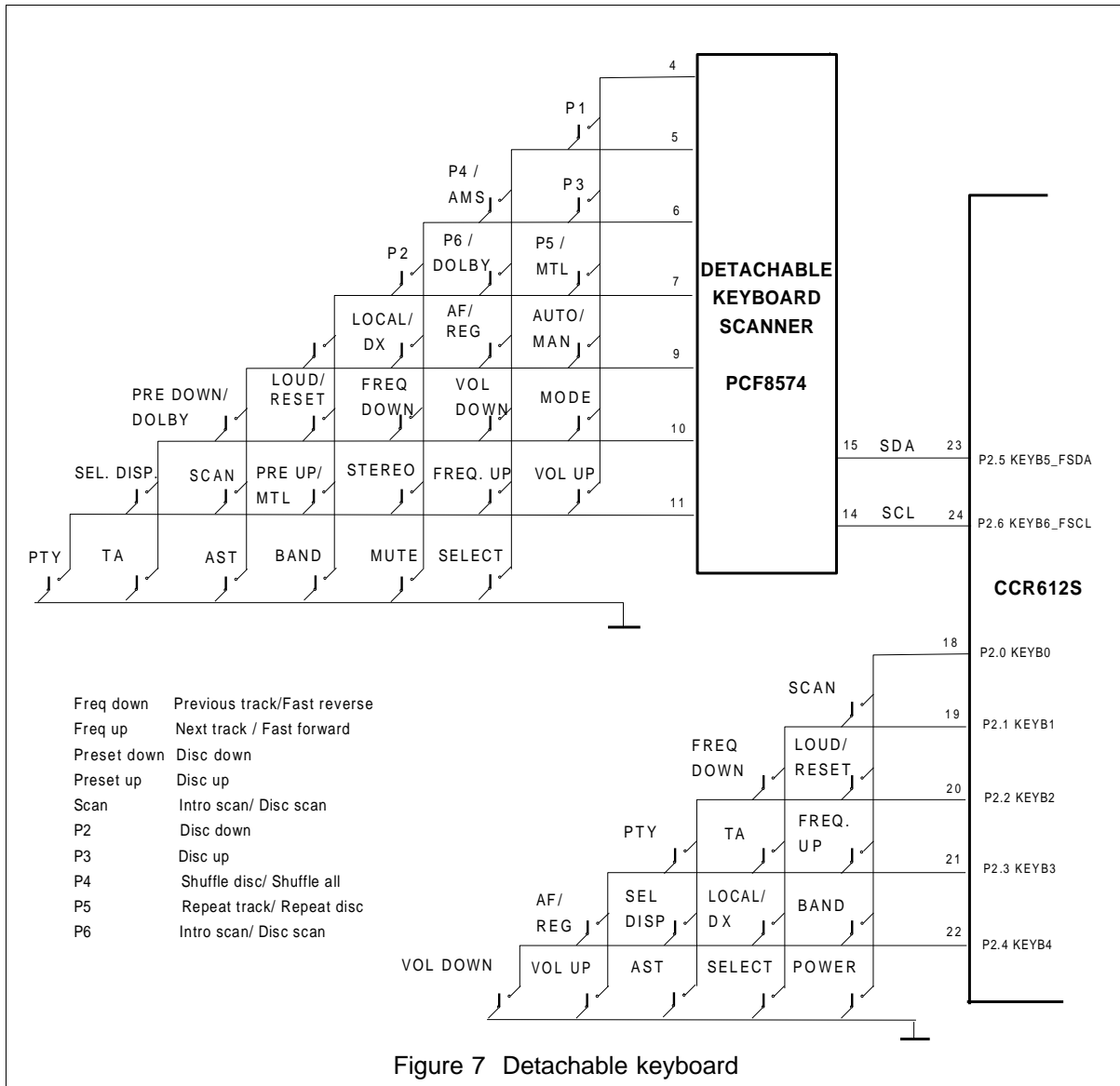
4.4.3   Keyboard options

Not all keys need to be installed. The following options are possible:

• Preset select options
1.   P-1 through P-6 keys.
        The function AMS is available in this case.
        SHUFFLE DISC, REPEAT TRACK, SHUFFLE ALL and REPEAT DISC are available now.
2.   PRE-UP / PRE-DOWN keys.
        The function AMS is not available in this case.
        SHUFFLE DISC, REPEAT TRACK, SHUFFLE ALL and REPEAT DISC are not available now.

- No digital sound control chip installed.
  In this case, the keys VOL-UP, VOL-DOWN are not required.

- The following keys are optional. If omitted, the related functionality is not available, but other functions are not affected.

  - AUTO/MANUAL   (Function also available by pressing FREQ-UP and FREQ-DOWN together)
  - LOUD   (Loudness function also available in user programmable options; reset function not available)
  - DISPLAY
  - PTY
  - MUTE
  - MODE
  - SCAN
  - LOCAL/DX

By means of an option diode, a selection can be made for a momentary power key (connected to port KEYB0 and ground) or a static on/off key (connected between port IGN and ground).

4.5   Power stabilizer interface.

For switching the radio on and off, the microcontroller is linked with the voltage stabilizer circuit TDA3602. The pins involved in this interface are RESET, ON and HOLD.

Figure 8 shows a circuit diagram of the reset circuitry and the voltage stabilizer interface.

The TDA3602 has a number of different states, which are selected by the voltage on the state control input V_{sc} on pin 4. The following states are used:

State	V_{sc}	Description
OFF	-	No power
COMA	> 3.6 V	State when radio is off. Microcontroller supply is in low current mode; other supply voltages are off.
RESET	$1.2V < V_{sc} < 2.0V$	State during reset. Microcontroller supply is in high current mode; other supply voltages are still off.
ON	< 1.2 V	State when radio is on. All supply voltages are on.

To switch the radio on, the voltage stabilizer must be brought in reset state. It generates a reset pulse for the microcontroller with its reset output pin. The microcontroller program starts, and decides whether the radio must stay on or must switch off again. When it must stay on, output pin "ON" is pulled low, bringing the TDA3602 in the "ON" state. Else, the stabilizer stays in reset state, or returns to coma state eventually.

The following events must bring the voltage stabilizer in reset state:

- Main power supplied
- Ignition or static on/off switch closed
- Power key pressed
- Power voltage is OK again after an engine start

The reset pulse for the microcontroller must be at least 20 msec. wide, measured at the threshold level (max. 3.5 V).

After the end of the reset pulse the power key is sensed and the "KEYB0" output is pulled low to keep the stabilizer into the reset mode.

When the radio should stay on, (see switching on and off, paragraph 6.1), the "ON" output is pulled low after the check of the option diodes and when the power key is released.

After approximately 400 msec., the microcontroller tests the HOLD input. If it is low, something is wrong and the set is switched off, but internally a reset will be generated and the set will try to switch on again. Else it is continuously monitored for supply voltage failure e.g. starting the cars engine.
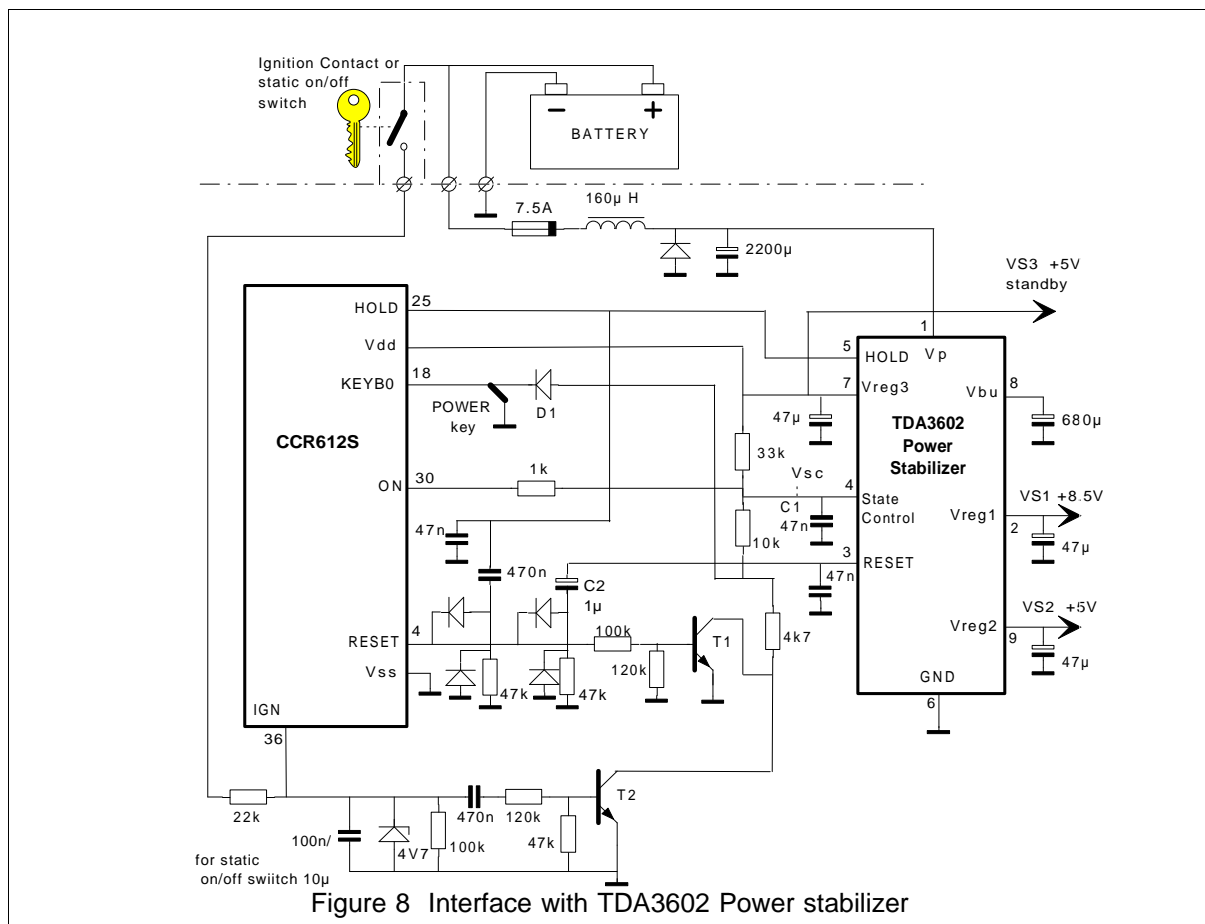
Figure 8 Interface with TDA3602 Power stabilizer

Note,
The power key is a momentary push-button, closed only as long as it is pressed down.

4.6 LCD display.

The LCD display is a 143 segment display, with a character set that includes umlaut (ü) characters.

The display consists of the following fields:

- Text field for 8 alpha-numerical characters;
- Numerical digit for display of the preset number;
- 15 Icons for: REG, EON, AST, SCAN, LOC, AF, TP, ST, TA, PTY, LOUD, DOLBY, CLIP, MTL, AMS.

Figure 9 shows a possible layout of the LCD display
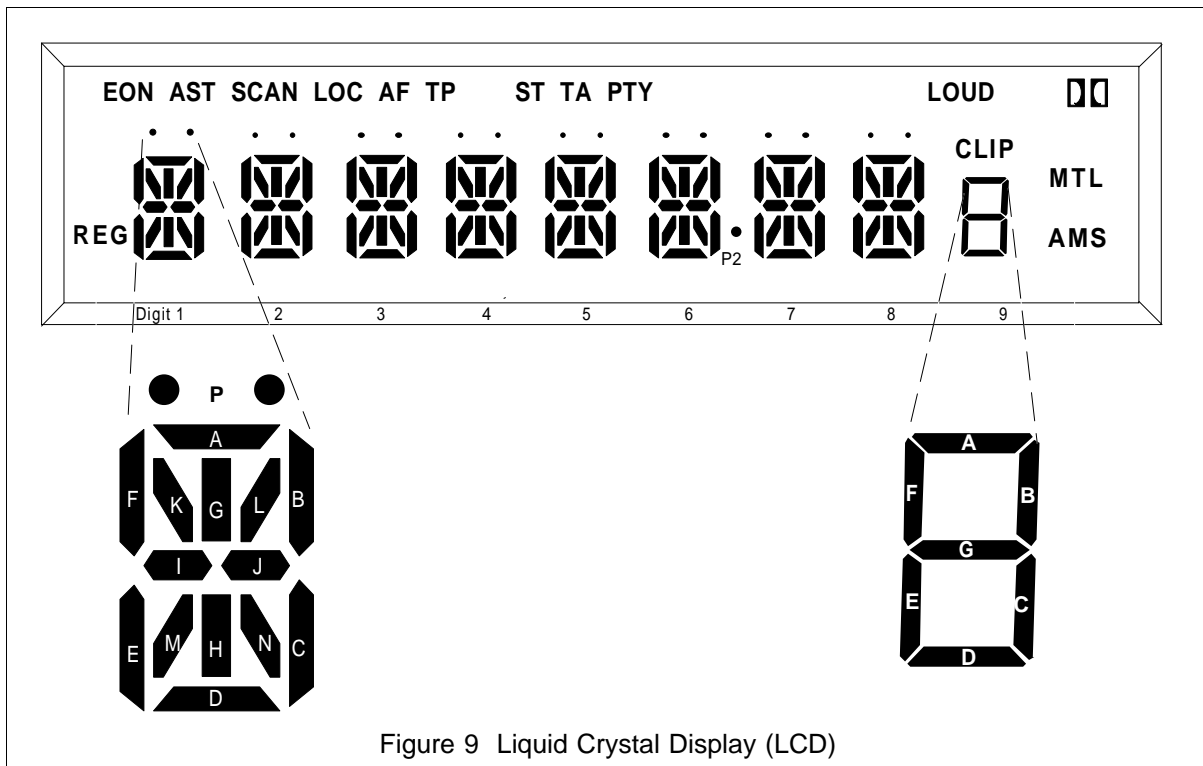
Figure 9 Liquid Crystal Display (LCD)

The 143 segment display is driven by one PCF8576 operating in 1:4 multiplex mode (4 backplanes BP0, BP1, BP2 and BP3) and a 1/4 (4 levels) LCD bias configuration.

Appendix II defines the connection of the segments of the display. Appendix III shows the character set. Figure 10 shows a diagram of the LCD driver interface.

Figure 10 Display module for 143 segments with PCF8576
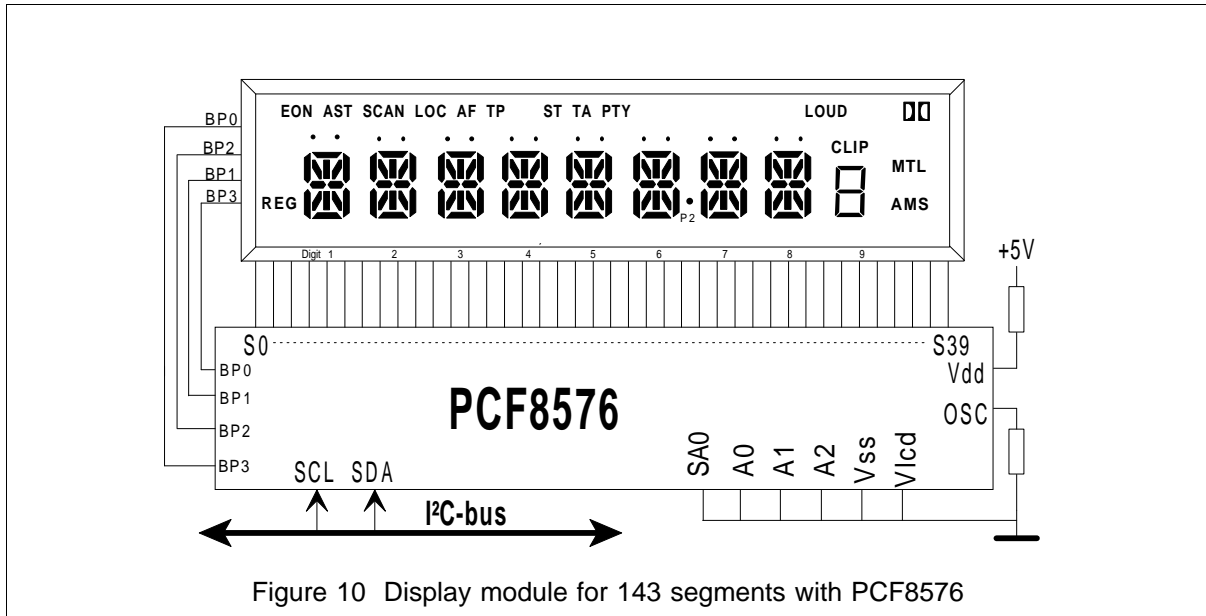
4.7   Non Volatile Memory.

This device is a 512 byte static CMOS EEPROM with I^2C-bus interface. It has low power consumption and guarantee a minimum of 100,000 erase/write cycles per byte and 10 years of non volatile data retention.

Figure 11 Non-Volatile Memory
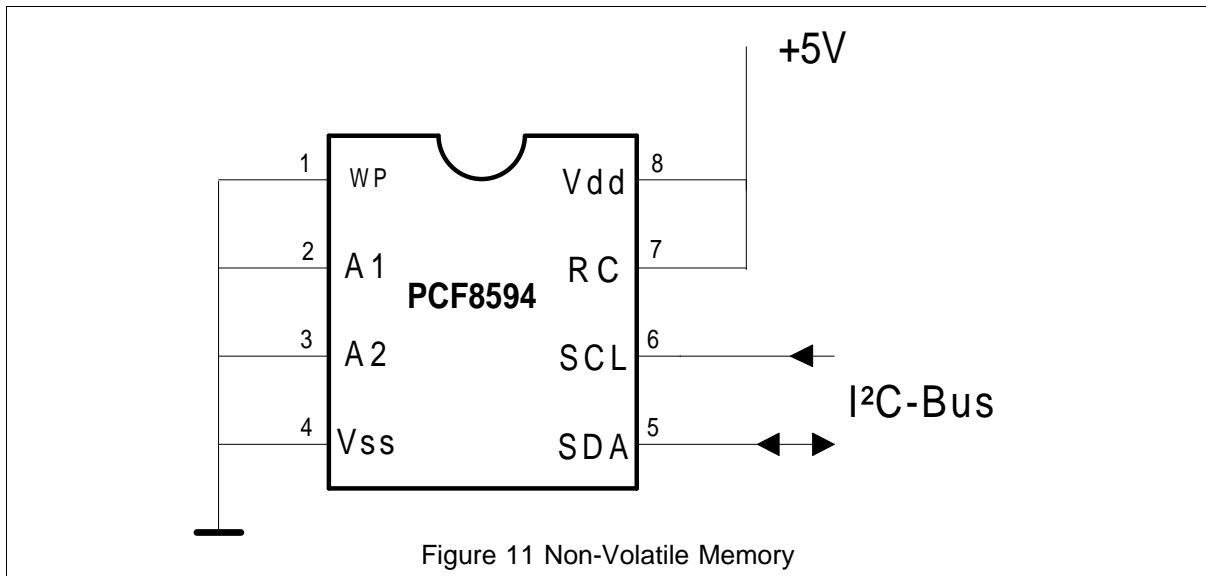
Appendix I shows the layout of data in the NVM.

User Manual of High-End RDS/EON **Car Radio System CCR612 (V0.3)**	**Application Note** **96029**

5   KEY FUNCTIONS

In the following table External mode is: CD-changer mode, Cassette mode or External plug mode.

Key	Description
POWER	When the radio is off, this key generates a reset pulse to start the microcontroller. The voltage stabilizer is switched on, but the radio will start playing only after the key is released.
	Pressed while the radio was on, the radio is switched off. It saves all information about its current setting, and restores the information when switched on again.
BAND	Step cyclically through the tuning bands (not accessible in Cassette & External mode) in the order:
	FM-1 -> FM-2 -> MW -> LW -> SW -> FM-1 -> ... FM-AST -> FM-1 -> ... MW-AST -> MW -> ...
	Depending on the installed band option diodes, the LW, MW and or SW bands may be skipped. Depending on the option concerning the band limits and tuning grid the LW band will be disabled (option set to USA).
	When a new band is selected, the radio is tuned to the preset or frequency that was last used in that band.
	In option programming mode, this key toggles the current option:
	2 SPKRS <-> 4 SPKRS LOUD OFF <-> LOUD ON TA LVL -2 <-> -1..0..+1..+2

Key	Description
AST	When pressed short (not in Cassette & External mode) : - If the radio is in FM-1 or FM-2 band, it switches to FM-AST band. - If the radio is in MW band, it switches to MW-AST band. - In other bands, nothing happens. In the new band, the radio selects the preset or frequency that was last used in that band. When pressed longer than 2 seconds (until the radio bleeps): The radio switches to FM-AST or MW-AST band as described above, and starts an AST search in that band. (Not in the LW, SW band). The TA mode is ignored during the AST search. In an AST search, the whole band is scanned, and the 6 strongest stations are stored in the 6 preset memories, strongest station first. When less than 6 stations are found, higher preset locations are not changed. When the AST search is completed, the radio bleeps and selects preset 1. The AST search can also be started if the radio is in cassette mode or in external mode.
AUTO/MANUAL	This key is used to switch between automatic and manual tuning mode (not in Cassette & External Mode). When in automatic tuning mode the FREQ-UP / FREQ-DOWN keys are pressed, the radio increases or decreases the frequency until a station is found. In manual tuning mode the frequency runs as long as the FREQ-UP / FREQ-DOWN key is pressed, and stops as soon as the key is released. The display will show the new state as either "AUTO" or "MANUAL" for 4 seconds. After that period, the band and frequency will be displayed for at least 2 seconds.
FREQ-UP FREQ-DOWN	These keys are used for tuning. Operation depends on the auto/manual switch. (FREQ-UP & FREQ-DOWN keys are not accessible in Cassette & External mode) The preset number is removed from the display when the radio was previously in preset mode (a preset number was displayed). The radio will be muted during tuning. The display will show at any moment the band and current frequency. When the two keys are pressed together, the radio switches between search/manual tuning just as if the AUTO/MANUAL key is pressed. This can be used as an alternative for the AUTO/MANUAL key.

Key	Description

(continued)
FREQ-UP
FREQ-DOWN

Automatic tuning mode:

The radio will increase/decrease the frequency until a new station is found. At the end of the band it will wrap around and continue on the other side. If after one bandsweep no stations are found and in Local mode the radio will switch to Dx mode, the search then will stop after one complete sweep in Dx mode.

Band	Frequency step size		
	USA		Europe
FM	200	kHz	100 kHz
MW	10	kHz	9 kHz
LW	-		1 kHz
SW	1	kHz	1 kHz

In FM:
- When TA mode is on, the search will only stop at traffic stations.

Manual tuning mode:

The radio will increase/decrease the frequency as long as the FREQ-UP / FREQ-DOWN key is pressed. The radio will go back to automatic tuning mode when the FREQ-UP / FREQ-DOWN keys are not pressed within 6 seconds.

	Band	Frequency step size		
		USA	Europe	
First step				
	FM	100	50	kHz
de-mute when key released	MW	10	9	kHz
	LW	-	1	kHz
	SW	1	1	kHz
After 0.5 seconds				
	FM	200	100	kHz
12.5 steps/second	MW	10	9	kHz
de-mute when key released	LW	-	1	kHz
	SW	1	1	kHz

In user option programming mode, the FREQ-UP / FREQ-DOWN keys are used to step through the available options. Each option can be toggled by the band key.

Key	Description
(continued) FREQ-UP FREQ-DOWN	CD-changer mode, short press. In CD-changer mode a short push on the FREQ UP and FREQ DOWN keys is used to respectively move one track up or one track down. CD-changer mode, long press. In CD-changer mode pushing FREQ UP or FREQ DOWN longer then two seconds is used to respectively play the CD fast-forward or fast-backward.
SCAN	Frequency Scan. Continuous automatic search tuning, pausing for 6 seconds on every station found. The search direction is always search up and the algorithm is the same as for the normal search, see keys FREQ-UP / FREQ-DOWN.
INTRO SCAN	CD-changer mode, short press. In CD-changer mode a short push on the SCAN key will start the intro scan mode of the CD-changer. The CD-changer will now play the first ten seconds of each track on the current CD. The intro scan mode can be cancelled by a second short push on the SCAN key, by pushing an other CD-changer control key or by leaving CD mode.
DISC SCAN	CD-changer mode, long press. In CD-changer mode a long push on the SCAN key will start the intro disc mode of the CD-changer. The CD-changer will now play the first ten seconds of each available disc. The disc scan mode can be cancelled by a short push on the SCAN key, by pushing an other CD-changer control key or by leaving CD mode.
P1 - P6	When pressed short, these keys select a preset programme directly. The AF follow mode on/off state will be set according to the state stored in NVM. When pressed longer than 2 seconds (until the radio bleeps), these keys serve to store the current station in preset memory. In FM, the state of the AF follow mode on/off switch is stored together with the frequency. Also the RDS PI code, programme service name and AF list are stored. In cassette mode, some of these keys have additional functions:
AMS	- P4 Switch the AMS function on/off. When on, the AMS icon is on.
MTL	- P5 Switch MTL mode on/off. When on, the MTL icon is on.
DOLBY	- P6 Switch DOLBY on/off. When on, the DOLBY icon is on.

Key	Description
(continued)	CD-changer mode, short press.
	In CD-changer mode, the keys P2, P3, P4, P5, P6 have additional functions:
DISC DOWN	- P2 Move to the next available disc
DISC UP	- P3 Move to an eventual previous disc
SHUFFLE DISC	- P4 Switch the CD-changer to shuffle mode. The CD-changer will now play the tracks on the current disc in random order. Shuffle track mode is cancelled by shortly pressing P4 once more or by selecting an other CD-changer mode.
REPEAT TRACK	- P5 Switch the CD-changer to repeat mode. The CD-changer will now repeat playing the current track. Repeat mode can be cancelled by shortly pressing P5 once more or by selecting an other CD-changer mode.
INTRO SCAN	- P6 In CD-changer mode a short push on the P6 key will start the intro scan mode of the CD-changer. The CD-changer will now play the first ten seconds of each track on the current CD. The intro scan mode can be cancelled by a second short push on the P6 key, by pushing an other CD-changer control key or by leaving CD mode.
	CD-changer mode, long press
	In CD-changer mode, a long press on the keys P4, P5, P6 provides additional functions:
SHUFFLE ALL	- P4 Switch the CD-changer to shuffle disc mode. The CD-changer will now play the tracks on the all available disc in random order. Shuffle disc mode is cancelled by shortly pressing P4 or by selecting an other CD-changer mode.
REPEAT DISC	- P5 Switch the CD-changer to repeat disc mode. The CD-changer will now repeat playing the current disc. Repeat disc can be cancelled by shortly pressing P5 or by selecting an other CD-changer mode.
DISC SCAN	- P6 In CD-changer mode a long push on the P6 key will start the intro disc mode of the CD-changer. The CD-changer will now play the first ten seconds of each track on the current CD. The intro scan mode can be cancelled by a short push on the P6 key, by pushing an other CD-changer control key or by leaving CD mode.

Key	Description
PRE-UP PRE-DOWN	These keys are installed only if the keys P1 - P6 are not installed. When pressed short, these keys are used to step to the next/previous preset programme. The AF follow mode on/off state will be set according to the state stored in NVM. When pressed longer than 2 seconds (until the radio bleeps), the current station is stored in the last selected preset number. In FM, the state of the AF follow mode is stored together with the frequency. Also the RDS PI code, programme service name and AF list are stored. When PRE-UP and PRE-DOWN are pressed together, the current programme can be stored in a preset number to be selected: 1. A blinking preset number will be displayed. 2. Press PRE-UP or PRE-DOWN to step to the desired preset number. 3. Press either PRE-UP or PRE-DOWN longer than 2 seconds (until the radio bleeps). The station is now stored. The preset number on the display becomes steady again. In cassette mode, these keys have additional functions:

MTL
 	
DOLBY
	- PRE-UP Switch MTL mode on/off
	                    When on, the MTL icon is on.
	- PRE-DOWN Switch DOLBY on/off.
	                    When on, the DOLBY icon is on.
	
	CD-changer mode:
	In CD-changer mode, the keys PRE UP and PRE DOWN P6 have additional functions:

DISC UP DISC DOWN	- PRE UP Move to the next available disc - PRE DOWN Move to an eventual previous disc
PTY	This key is active only if the radio is in FM. When pressed the current received PTY code is displayed. In case no PTY code is received, "NO PTY" is displayed. The user can now select a PTY code with FREQ-UP / FREQ-DOWN keys. When no key was pressed for 6 seconds, the radio returns to normal mode. The PTY scan is started by pressing the PTY key for 2 seconds (until the radio bleeps). A search is started for the selected PTY code. When a PTY code is received the PTY icon is on. When a PTY search is busy, the PTY icon is blinking.

Key	Description
TA	This key is active only if the radio is in FM.

It serves to switch TA mode on/off.

When TA mode is on, and a traffic announcement is transmitted:
- If the radio is muted, it will be de-muted for the duration of the traffic announcement.
- If the radio was in cassette or external mode, it will switch temporarily to radio mode.
- Temporary switch over to an EON linked station when EON detects a traffic announcement on that other station.
- If the volume setting was very low, it will be raised temporarily. If the user does not change the volume setting, it will return to the original value at the end of the traffic announcement.
- The TA icon (and the EON icon in case of EON TA) will blink.

The current traffic announcement can be cancelled by pressing the TA key, the TA mode will not be switched off. This can be useful to cancel for example an unwanted EON traffic announcement.

The radio will automatically start a search when switching on TA mode and the current station is not a traffic station.

Key	Description
AF	When pressed short: Switches AF follow mode on/off. The state of the AF follow mode is displayed by the AF Icon: Icon off: AF follow mode off Icon on: AF follow mode on; RDS reception OK. Icon blinking: AF follow mode selected, but no RDS data received. When AF follow mode is on, the radio will from time to time measure the signal strength of the alternative frequencies that come with the RDS data. The interval between measurements depends on the signal strength of the current station, in the order of 1 minute for strong stations to a few seconds for weak stations. When the radio finds an alternative frequency that is - in several successive measurements - stronger than the current frequency, it switches over to that frequency.

REGIONAL	When pressed longer than 2 seconds (until the radio bleeps):
	Toggles the regional on/off status displayed via an icon.
	
	To check whether an alternative frequency is a real alternative for the current station, the radio compares PI codes.
	
	- Regional mode is on:
	  The PI codes must be exactly identical or a SUPRA regional variant.
	- Regional mode is off:
	  The region identification code in the PI code is ignored.
	
	When regional mode is off, the radio may switch to any programme service carrying a PI code equal to the current PI code. In this case the regional identification is not taken into account. When regional mode is on, the radio will only switch to a programme service carrying exactly the same programme. In both cases the radio may switch to transmitters broadcasting in Supra-regional mode. For USA application (RBDS) the regional function will only work for PI codes above $B000_{hex}$. PI codes below $B000_{hex}$ do not have regional variants. AF switching is only allowed to stations with exactly the same PI code.

Key	Description

DISPLAY	By default (in radio mode), the display will show the programme service name of the current station, or - when not available - the band and frequency.
	
	The display key serves to show available information:
	    - Programme TYpe name
	    - Band and frequency
	    - Programme Service name
	
	Each time this key is pressed, the display changes to the next item in the list. If an item is not available, it is skipped.
	
	When the display key is not pressed within 6 seconds, or when any other key is pressed, the display returns to the default state.

DISPLAY	CD-changer mode. In CD-changer mode the key DISPLAY is used to show the time played from the current track. The display mode will be cancelled automatically after ten seconds.
VOL-UP, VOL-DOWN	These keys are installed only if a digital sound control chip is installed. The VOL-UP and VOL-DOWN keys increment/decrement the setting of the current analogue function. The setting is changed with 4/8 steps per second, as long as the key is held down, or until the end of the range has been reached. For volume, balance and fader, each step is variable dB (8 steps per second), for bass each step is 1.5 dB (TEA6320/6322) or 1.8 dB (TEA6321/6323) and for treble each step is 1.5 dB (4 steps per second). By default, volume is changed. No indication on the display is given in that case. With the select key, the function on which the VOL-UP and VOL-DOWN keys operate can be changed to: bass, treble, balance or fader. (See select key description). In these modes, the setting is shown on the display.

SELECT	When pressed short:
	    It changes the function on which the VOL-UP, VOL-DOWN keys operate to: bass, treble, balance or fader. Each time the key is pressed, the next function is selected.
	    The fader function is only available if the 2/4 loudspeakers option in the user programmable options was set to "4 SPKRS".
	    By default, the VOL-UP and VOL-DOWN keys operate on volume. When none of the keys select, VOL-UP or VOL-DOWN is pressed within 6 seconds, or when any other key is pressed, the default function volume is restored. This key function is disabled if no digital sound control chip is installed.

Key	Description

(continued)
SELECT
	When pressed longer than 4 seconds (until the radio bleeps):
	   User option programming mode is entered.
	
	In this mode the user can select the next options:
	  - 2-Loudspeakers / 4-Loudspeakers,
	      (in 2-speaker mode, the fader function is not available).
	      (This option is skipped when no digital sound control chip is installed).
	  - Loudness on/off,
	      (alternative for the loudness key, if loudness option is available).
	  - TA volume (A selection can be made of 5 different sound levels for traffic news and PTY alarm messages This option is skipped when no digital sound control chip is installed).
	
	The FREQ-UP / FREQ-DOWN keys must be used to step through the functions that can be selected.
	The band key must be used to toggle an option.
	
	The user option programming mode is left when the select key is pressed again, when none of the keys select, FREQ-UP / FREQ-DOWN or band is pressed for 6 seconds, or when any other key is pressed.

LOUD	When pressed short: Toggles the loudness on/off state. When loudness is on, bass and treble is added to the analog settings when the volume setting is low.
RESET	When pressed longer than 4 seconds (until the radio bleeps): Performs an analogue reset function: bass, treble, balance and fader are set to mid-range, and loudness is switched off.

MUTE	This key serves to switch the "muted" state on/off.
	When muted:
	  - All audio output is suppressed
	  - The text "MUTE" is displayed.
	  - In cassette mode the cassette player will be stopped.
	  - In CD-changer mode the CD-changer will be stopped.
	
	The muted state is switched off, when the mute key is pressed again, or when any other key is pressed. The muted state will be temporarily suspended when the radio is in TA mode and a traffic announcement is received, or when a PTY alarm message is received.

Philips Semiconductors

Key	Description
STEREO	This key is only active in FM. It is used to force mono reception if stereo reception has too much noise. The mono/stereo state is reset to stereo by all user tuning operations or preset selections. After pressing the key, the current state is displayed in the LCD text window by means of the text "STEREO" or "MONO" for 4 seconds. If - within that period - the key is pressed again, the state is toggled (only possible when a stereo transmitter is received), and the new state is displayed - again for 4 seconds. The stereo icon on the display shows the state of the stereo decoder. The icon is on in case of stereo reception. The icon is off in case of mono reception or in case forced mono is selected.
LOCAL/DX	This key can be used to control an attenuator in the FM antenna circuit during search. Attenuation may be inserted to reduce intermodulation caused by strong adjacent stations. By pressing the LOCAL/DX key, the current Local / Dx status is toggled. This status is displayed via an icon. For FM, the Local / Dx switch is incorporated in the TEA6811. Putting the radio in Local mode results in an attenuation of the aerial signal with 15 dB. For AM, the signal levels read back from the TEA6822 are used to create the Local /Dx functionality. In AM mode, the search stop level for Local is set 22 dB higher than when the radio is in Dx-mode.
MODE	This key is used to overrule the default selection of the audio source: radio, CD-changer, cassette or external. Each time the key is pressed, the next input source is selected in the order: radio -> CD-changer -> cassette -> external with the restrictions: - CD-changer is selected only if the CD-changer was connected during power-on. - Cassette is selected only if a tape is present in the cassette deck. - External is selected only if a connector is inserted in the external input jack.

Philips Semiconductors

6   FUNCTIONAL DESCRIPTION
6.1   Switching on / off

To switch the radio on, a reset pulse must be applied to the microcontroller. The software will then perform a number of checks, and may either turn on all voltages, or switch the radio off again.

With a bad battery, the voltage may drop so far that the "HOLD" output of the voltage stabilizer goes low, e.g. during starting of the cars engine, and the radio switches off. The radio will switch on immediately when the voltage returns to a normal value.

If the radio was previously switched off by turning the ignition off, it will switch on when the ignition key is turned on again.

The radio can also be switched on with the power key while ignition is off. In that case a sleep timer is started that turns the radio off after 60 minutes unless ignition is switched on in the mean time.

The table below shows the differences between the static on/off switch and the momentary power key.

Option	Pin or key	Switch on	Switch off
Momentary on/off key	Power key	Power key pressed.	Power key pressed.
	IGN pin	When previous switched off by IGN.	When IGN pin goes low.
			After 60 minutes when switched on by power key while IGN pin was low.
Static on/off switch	Static switch	When switch is closed.	When switch is open.
Valid for both	Power supply	When power supply is OK again.	When a power failure is detected.
	Detachable keyboard		When keyboard is removed.

6.2 Tuning

6.2.1 Band switching

Band switching can be done with the AST and BAND keys (see Figure 12). In the AST bands, the AST icon is on. Band switching is only accessible in Radio Mode.

Figure 12 Band selection
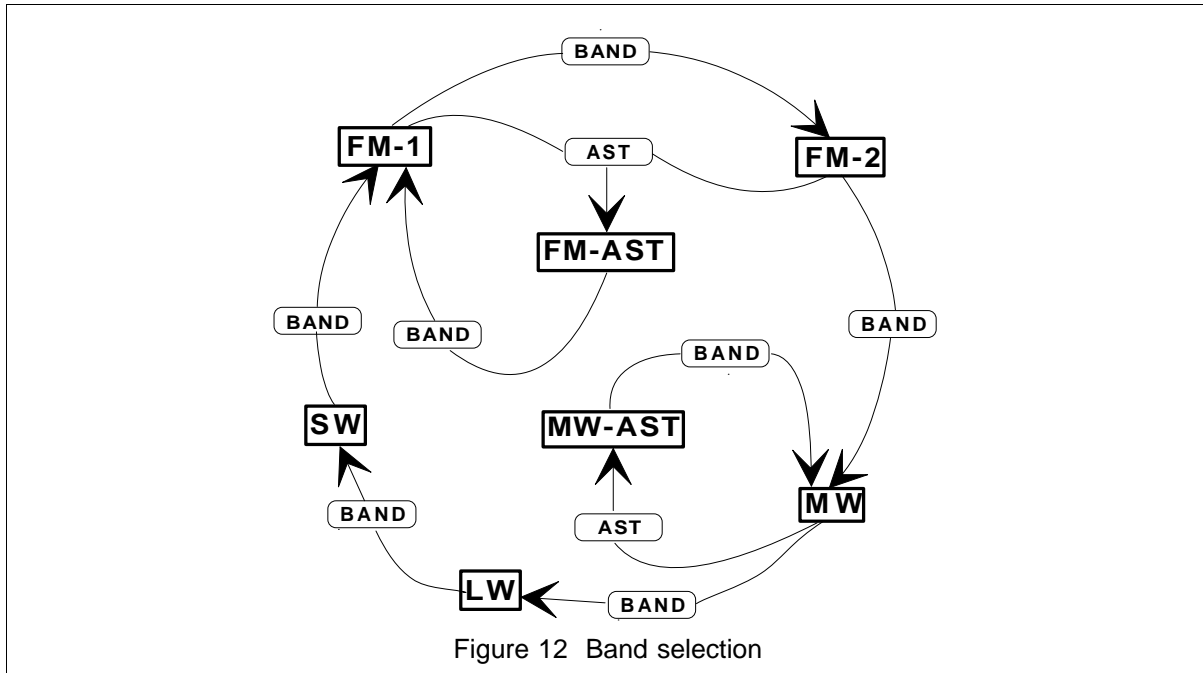
6.2.2 Manual/search tuning

Figure 13 shows how to switch between the tuning modes. In preset mode, a preset number is shown on the display. In other modes, no preset number is shown. When leaving preset mode, any update of preset data (current frequency, PS name, AF list, AF follow mode bit) is stored in NVM. Switching of tuning mode may be done either by pressing FREQ-UP and FREQ-DOWN keys together, or by pressing the AUTO / MANUAL key. When pressing AUTO / MANUAL or FREQ-UP / FREQ-DOWN, a message "AUTO" or "MANUAL" is shown on the display to indicate the new state.

When key FREQ-UP or FREQ-DOWN is pressed, the radio will make one frequency step. When the key is pressed longer than 0.5 seconds, the frequency will start to run with a repetition rate of 12.5 steps per second.

First tuning step
  - De-mute at key release
  - Frequency step size:

	SW	LW	MW	FM	
USA	1	-	10	100	kHz
Europe	1	1	9	50	kHz

Repetitive steps (after 0.5 sec)
- 12.5 steps/sec
- De-mute at key release
- Frequency step size:

	SW	LW	MW	FM	
USA	1	-	10	200	kHz
Europe	1	1	9	100	kHz
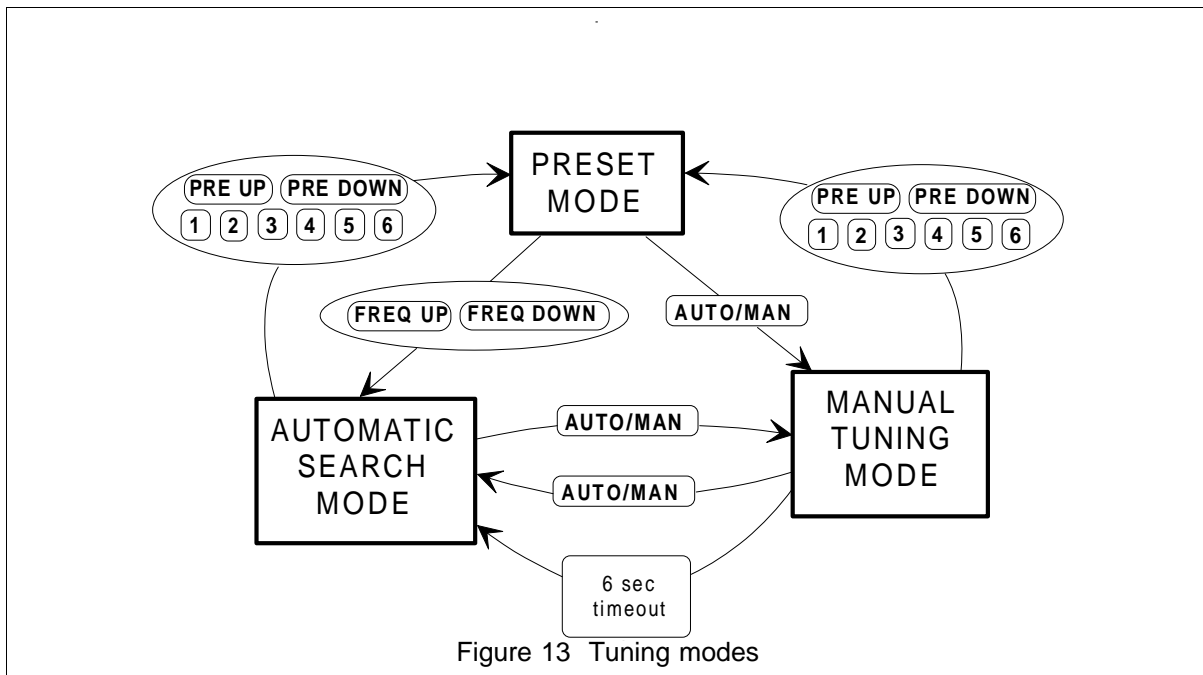
Figure 13 Tuning modes

In search tuning mode, after pressing the FREQ-UP / FREQ-DOWN key, the frequency starts running and will stop on either a new frequency or at the frequency from which the search was started. For this search action two criteria are taken into account:
- search sensitivity Local (high signal level) or Dx (low signal level).
- Ta mode on, the search will only stop at traffic programmes.

When the radio is in Local mode and after one band sweep no station was found, the search sensitivity is switched to Dx. If still no valid station can be found, the radio returns to the frequency from which the search was started.

Depending on these criteria a maximum of two band sweeps will be made, trying to offer a frequency fulfilling the search criteria.

For FM, a Local / Dx switch is incorporated in the TEA6811. Putting the radio in Local mode results in an attenuation of the aerial signal with 15 dB. For AM, the signal levels read back from the TEA6822 are used to create the Local /Dx functionality. In AM mode, the search stop level for Local is set 22 dB higher than when the radio is in Dx-mode.

During a tuning action - manual or automatic - the display will show the running frequency at any time.

6.2.3   Frequency scan

The frequency scan mode enables the user to listen to all stations transmitted in the selected band (FM, MW, LW or SW). The radio pauses for 6 seconds on every station found before search is started again. During frequency scan, TA mode is included in the stop criteria in the same way as during normal search. EON traffic announcements are skipped during frequency scan mode.

Frequency scan is cancelled by every other tuning function. The radio will switch to the last valid station when the cancelling takes place during search. Frequency scan mode is only accessible when the radio is in Radio Mode.

6.2.4   Selecting preset stations

In each band, there are 6 presets. To select a preset station:

If the radio is equipped with 6 preset selection keys (P1 - P6)
  - Press short on the key of the desired station.

If the radio is equipped only with PRE-UP / PRE-DOWN keys
  - Press either PRE-UP or PRE-DOWN repeatedly until the desired station is selected.
    (Do not hold down the key, because then the preset store function will be executed).
    If initially no preset number was displayed, the first preset selected will be the last preset number used in the band.

Selecting preset stations is only accessible in Radio Mode.

6.2.5   Storing stations in preset memory

If the radio is equipped with 6 preset selection keys (P1 - P6)
  - Press key of the preset number to be stored until the radio bleeps (2 seconds).
    The station is now stored.

If the radio is equipped only with PRE-UP / PRE-DOWN keys
  - If the current preset number is the desired preset number:
    - Press either the PRE-UP or PRE-DOWN key until the radio bleeps (2 seconds).
      The station is now stored.

  - If the current preset number is **not** the desired preset number:
    - Press keys PRE-UP and PRE-DOWN at the same time.
      The preset number will start to blink.
    - Press either PRE-UP or PRE-DOWN repeatedly until the desired preset number is displayed.
      (The tuned frequency does not change).
    - Press either the PRE-UP or PRE-DOWN key until the radio bleeps (2 seconds).
      The station is now stored. The preset number stops blinking.

    The preset store mode is cancelled when the PRE-UP and PRE-DOWN are pressed again together, when an other key is pressed or when no key is pressed for 6 seconds.
Storing stations in preset memory is only accessible in Radio Mode.

6.2.6   AST search

To start an AST (Automatic Store Tuning) search, press the AST key until the radio bleeps (2 seconds). Now, the following actions are taken:

1. If the radio is not in an AST band, it switches to the relevant AST band

    FM-1,   FM-2   -> FM-AST
    MW   -> MW-AST

    AST is not available in the LW and SW bands.

2. The 6 strongest stations will be stored in the NVM, ignoring TA mode. The whole band is scanned for transmitters, a maximum of two sweeps will be made, one in Local mode and if necessary one in Dx mode). If less than 6 stations were found, the last preset memory locations are not replaced.

3. Preset-1 is selected.

During the whole process, the radio is muted and the message "STORE" is shown on the display unless the radio is in CD-changer / External / Cassette Mode.

6.2.7   The LOCAL/DX key

The user can control the search sensitivity of the radio via the so called Local/Dx feature. In Local mode, the radio will only stop at strong stations. In Dx mode, a search action will also stop at weaker stations. The Local/Dx status is displayed via an icon. After power on, the radio will always go in Dx mode.

When the radio is in search tuning mode the tuner Local/Dx status depends on the Local/Dx setting. As soon as the radio is in stable tuning condition the tuner attenuator status will be Dx.

6.3   CD-Changer, Cassette and external source interface

CCR612 is equipped with five different audio sources (radio, CD-changer, cassette, external plug and bleep) each source is associated with a corresponding mode. Only one source can be selected at a time. Source selection is accomplished by the sofac or by source select pins in case no sofac is installed. Source switching can be invoked in two ways. The first way is pushing the MODE key, this will result in toggling through all available sources(Radio, CD-changer, Cassette, External plug, Radio). Furthermore an external event can invoke the source switching (see Figure 14). The following external events are possible: insert cassette, eject cassette, insert external plug and remove external plug.

Automatic selections can be overruled by the MODE key.

When the radio is switched off, the source select state is stored in NVM. The same state is selected again when the radio is switched on.
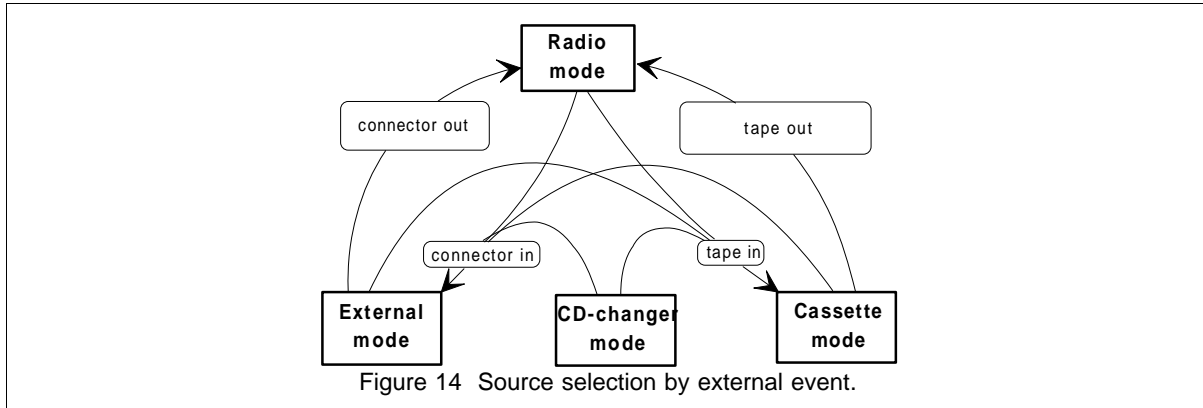
Figure 14 Source selection by external event.

6.3.1   The MODE key

Automatic source selection can be overruled by using the MODE key. Each time the MODE key is pressed, the next source is selected in the order:

Radio -> CD-changer -> Cassette -> External.

Cassette mode can be selected only if a tape is present in the cassette deck.
External mode can be selected only if a connector is present in the external audio jack.

6.3.2   CD-changer mode

The presence of a CD-changer is asserted during the power-on phase of the radio. The CD-changer can only be selected if the CD-changer was present during power-on. The CD-changer mode can only be selected with the MODE key.

While in CD-changer mode the following key mapping applies:

TABLE Key mapping in CD-changer mode

Key	short press	long press
FREQ-UP	NEXT TRACK	FAST FORWARD
FREQ-DOWN	PREVIOUS TRACK	FAST REVERS
PRE-UP	DISC UP	
PRE-DOWN	DISC DOWN	
P2	DISC DOWN	
P3	DISC UP	
P4	SHUFFLE DISC	SHUFFLE ALL
P5	REPEAT TRACK	REPEAT DISC
P6	INTRO SCAN	DISC SCAN
SCAN	INTRO SCAN	DISC SCAN

6.3.3   Cassette functions

The cassette interface is based on a mechanical tape deck. When a cassette is playing, the display will show the text "PLAY >" or "PLAY <" indicating the play direction. During fast winding, no direction information is available. The display will show "CAS WIND". When fast winding for more than 4 seconds, the set will temporarily switch to radio mode.

While in cassette mode, the keys P-4, P-5/PRE-UP and P-6/PRE-DOWN control the functions AMS (Automatic Music Search), MTL (Metal/Chromium) and Dolby respectively. The keys toggle the corresponding output pins, the function itself is executed by the cassette deck circuitry. When a function is not available in the cassette deck, the corresponding pin must be connected to ground.

The state of the AMS, ME/CR and Dolby functions is displayed by icons. If a TEA632x is installed the cassette solenoid and AMS pause function are available. The solenoid function takes care of playing in the correct direction after switching to cassette mode and together with the AMS pause function, it takes care of controlling the AMS function. Search (in both directions) for the next music piece by detecting a blank area on the tape. If no TEA632x is installed (potentiometer sound control) the AMS function and the solenoid function are not available. If the cassette drive does not have the AMS function the CAMS pin must be connected to ground.

6.3.4   External audio source

An external audio input is available to connect e.g. a CD player. The external input jack has a switch to sense whether a connector is inserted. While the radio is in external mode, the text "EXTERNAL" is shown on the display. When no external audio selection is available the EXSTAT pin must be connected to Ground.

6.4   Audio control

Most of the audio control facilities are available only if a digital sound and fader control chip (Sofac) is installed. If no digital sound control chip is used, the following signals should be used in combination with potentiometer control:

- pin AUMUTE   Mute status;
- pin LOUDN   Loudness status;
- pin TA   Traffic announcement or PTY alarm message in progress;
- pin SEL0 / SEL1 Source selection.

The volume at power on is limited to -10 dB when digital sound control is available.

6.4.1   The SELECT key

By default, the VOL-UP and VOL-DOWN keys control the volume. To select other functions, press the select key short until the desired function is shown on the display. Figure 15 shows how control functions are selected using the select key. If the 2-speaker option is selected in the user programmable options, the fader function is not available and the fader setting is always mid-range. This function is disabled if no digital sound control chip is installed.

Figure 15 Selection of sound control functions
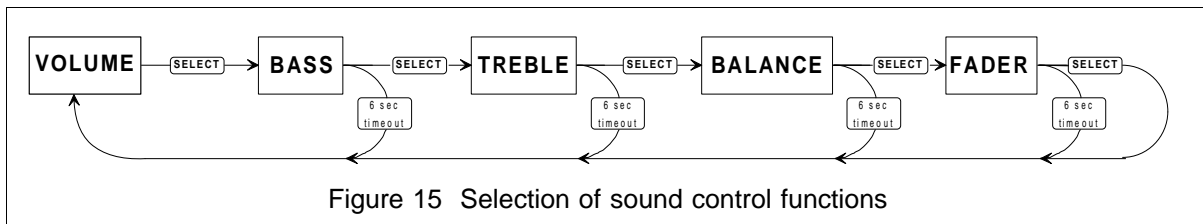
6.4.2   Changing a setting

To change a setting, press the VOL-UP or VOL-DOWN key until the desired level is reached. As long as a key is pressed, the bass and treble function changes with 4 steps per second and the volume, balance and fader function will change with 8 steps per second. The table below shows the control range and step size for the audio control functions.

Function	Step size TEA6320,6322/ TEA6321,6323	Range
Volume	variable	mute, -61 dB, -53 dB, -47 dB, -43 dB, -39 dB, -37 dB -35 dB, -33 dB, -31 dB, -30 dB, -29 dB, .. +19dB, +20 dB
Bass	1.5 dB/ 1.8 dB	-15 dB to +15 dB / -18 dB to +18 dB
Treble	1.5 dB	-12 dB to +12 dB
Balance	variable	rigth: mute, -30 dB, -22, -16, -12, -8, -6, -4, -2, 0 dB left: 0 dB, -2, -4, -6, -8, -12, -16, -22, -30 dB, mute
Fader	variable	front: mute, -30 dB, -22, -16, -12, -8, -6, -4, -2, 0 dB rear: 0 dB, -2, -4, -6, -8, -12, -16, -20, -30 dB, mute

The volume setting is not shown on the display. Other functions are shown on the display(e.g. BASS +6).

6.4.3   The LOUD key / RESET function

Loudness is switched on/off by pressing the LOUD key short. When loudness is on, bass and treble are added to the audio signal, depending on the volume level. The loudness function is carried out by the TEA632x. If no TEA632x is installed the loudness function is carried out by external loudness circuitry controlled by the LOUDN pin. The loudness on off status is displayed via an icon. When the loudness key is pressed for 4 seconds (until the radio bleeps), the reset function is executed. This function sets bass,

treble, balance and fader to mid-range and will switch loudness off. The display shows the text "RESET" for 2 seconds.

6.4.4   The MUTE key

When the mute key is pressed, all audio output is suppressed, and the display will show the text "MUTE". Any keypress will cancel the mute state. The audio control settings are not altered. When TA mode is on and a traffic announcement or a PTY alarm message is broadcast, the mute state is temporarily suspended.

6.4.5   Phone mute

When pin Aumute is pulled to ground externally by a connected car phone, the car radio sound is muted and the display will show "PHONE".

6.4.6   Power amplifier diagnostics control

CCR612 can be equipped with power amplifiers with a diagnostics interface. This interface consists of one pin which is low at erroneous situations. CCR612S will continuously monitor this pin and can detect one of the following situations:

Clipping
- The bass and or volume level will be decreased depending on the amount of clipping.
- While clipping is detected and clipping control is active the clipping icon is on.

Too high temperature / short circuit
- CCR612 will display the error message "ERROR" on the LCD.

6.4.7   User programmable options

Some options can be programmed by the user. The options are stored in NVM, and remain in effect until reprogrammed by the user. The options are:

2 SPKRS / 4 SPKRS
Indicates how many loudspeakers are connected to the radio. If "2 speakers" is selected, the fader function is not available, and fader setting is always mid-range.

LOUD ON / LOUD OFF
If no loudness key is installed, loudness can be switched on/off using this option in case the loudness function is available.

TA LVL -2 / -1 / 0 / + 1 / + 2
The volume level during a Traffic Announcement or PTY Alarm can be set to one of 5 fixed values varying from -12 dB to -4 dB in steps of 2 dB. When this function is selected during Traffic Announcement or PTY Alarm the volume level will change to the level selected.

Figure 16 explains how user options can be programmed.

Figure 16 Programming user options
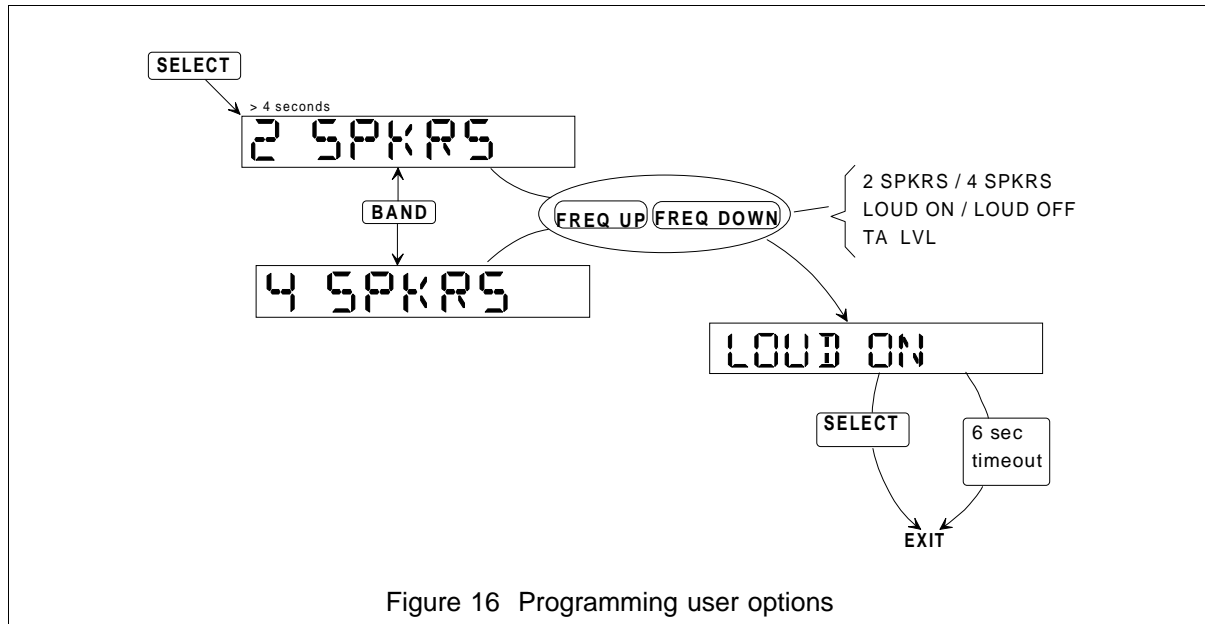
6.5   RDS / RBDS functions

The RDS / RBDS functions are available only if the radio is tuned to an FM band.

6.5.1   AF follow mode

The AF follow mode mechanism is switched on/off by pressing the AF key short. When AF follow mode is on, the AF icon is switched on. If no RDS data is received, the AF icon blinks.

In AF follow mode, the radio measures at regular intervals, (interval time depends on the signal quality), the signal level at frequencies that are mentioned in the list of alternative frequencies (AF's) for the current station. For these measurements, the reception of the current station is interrupted for a very short period (appr. 7 milliseconds), and it is hardly noticeable. If an alternative frequency is stronger than the current station for a few seconds (depending on the signal quality), the radio switches to that alternative frequency. It switches also if the quality of the current station becomes suddenly very poor, or if its RDS data cannot be received. The quality of a station is a function of signal level as well as multipath condition.

The AF follow mechanism is always active when AF follow mode is on, even when the radio is muted or is in CD-changer or cassette or external mode.

When the user starts a tuning action (band, preset, FREQ-UP / FREQ-DOWN), or when the radio is switched off, the new frequency and the AF list are stored in NVM. These will be used later on when selecting the preset again.

6.5.2 PTY functions

CCR612 offers the user the possibility to search for a station with a certain user selected PTY code. When key PTY is pressed, the currently received PTY code is displayed. If no PTY code is received the display will show "NO PTY" . By pressing the key FREQ-UP or FREQ-DOWN, the user can select the PTY code of his choice. When key PTY is pressed for 2 seconds (while the radio is in the PTY selecting mode), the radio will start a PTY search for the selected PTY code. Figure 17 shows how to select a programme type. Only one programme type can be selected.
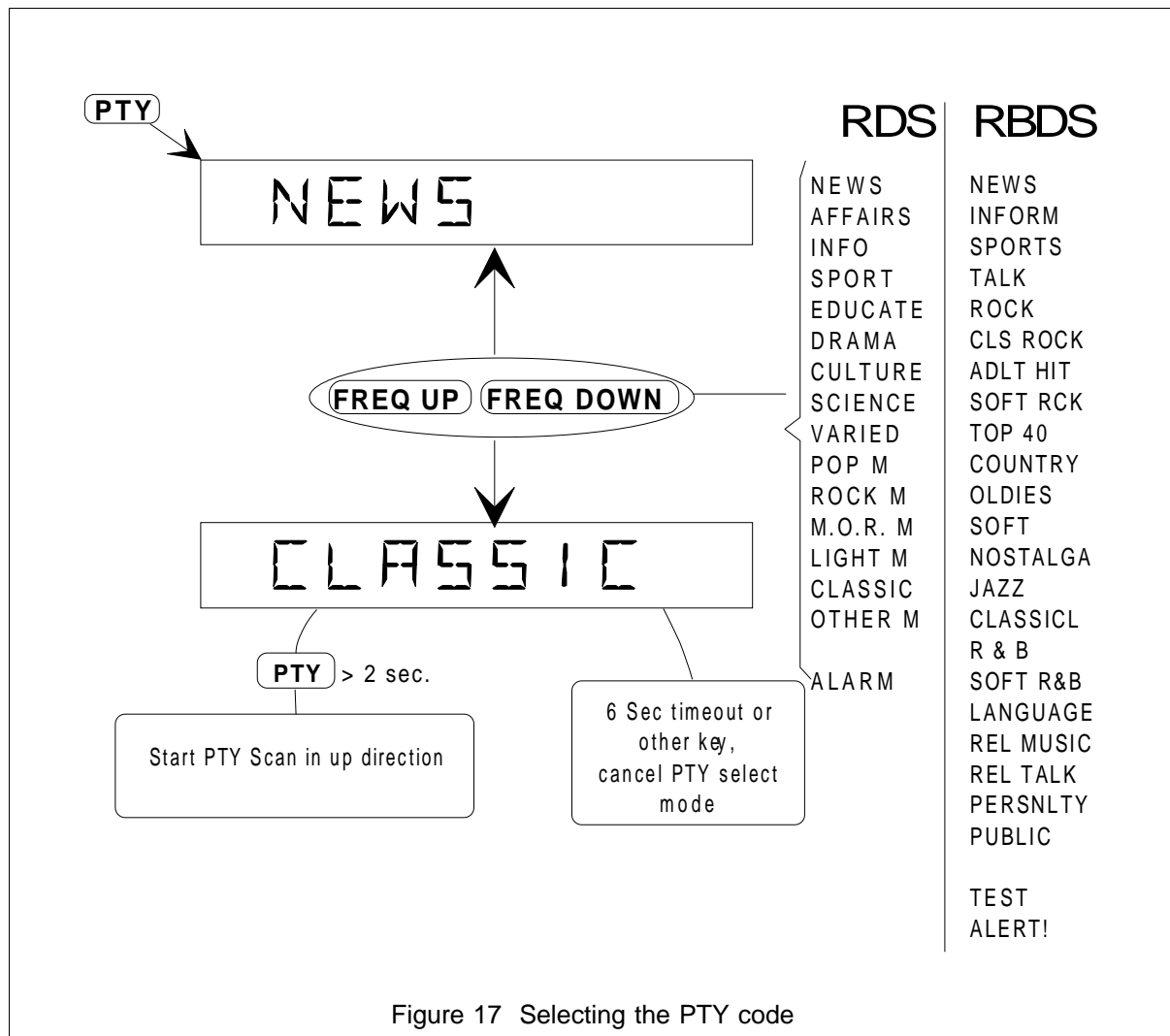
Figure 17 Selecting the PTY code

PTY codes "ALARM" / "TEST" / "ALERT!" can not be selected. The radio will respond to a PTY alarm message in the same way as a TA traffic announcement, independent of TA mode. For the USA application the RBDS PTY table is used.

During a PTY search the PTY icon blinks. When the radio receives a PTY code, the PTY icon is on.

When TA mode is on during a PTY search, the radio will first try to find a station which is a traffic station with the correct PTY code. When no such station can be found (even not in Dx mode), the radio will drop

the TA requirement and search only for a station with the correct PTY code. If still no station can be found, the radio will return to its original tuned frequency.

6.5.3   Traffic announcements

Traffic announcements have a special meaning only when TA mode is on.

To switch TA mode on/off, press the TA key. When TA mode is on, the TA icon is on. If the current station is not a traffic station, the TP icon blinks, and a warning bleep is generated every 30 seconds.

If TA mode is on, the next happens when a traffic announcement is broadcast:

1. If the traffic announcement is detected via EON, the radio will switch to the linked programme service transmitting the traffic announcement. The radio will stay at least 4 seconds on this programme before switching back to the original programme to give the broadcaster time to synchronise the RDS TP and TA data over its network.
   AF follow mode is disabled during an EON traffic announcement.

2. If the radio is in CD-changer, cassette mode or in external mode, it switches temporarily to radio mode, and the display will show the programme service name of the received station.

3. If the radio is muted, it is temporarily de-muted, and the "MUTE" message is removed from the display.

4. If the volume was low, it is raised to the TA volume level as installed under the user options (see: user programmable options). Also, the TA output pin is made low.

5. The TA icon blinks. In case of a traffic announcement on an EON linked station, the EON icon will also blink.

At the end of the traffic announcement, the old situation is restored again (after an EON traffic announcement the radio will switch back to the original station). If the user has not changed the volume setting, it is restored to the value before the traffic announcement. If the volume level was changed, the new value will be retained.

The current traffic announcement can be cancelled by pressing the TA key, the TA mode remains on.

6.5.4   PTY alarm broadcasts
A PTY alarm message is treated the same way as a traffic announcement. A PTY alarm message will break-in, even when TA mode is off.

7   RDS / RBDS FACILITIES.

As soon as the radio is steadily tuned to an FM station, it will start collecting RDS information. The next items are extracted from the stream of RDS data:

- PI   Programme Identification code;
- PS   Programme Service name;
- PTY   Programme TYpe code;
- TP   Traffic Programme bit;
- TA   Traffic Announcement bit;
- AF   Alternative Frequency list;
- EON   Enhanced Other Network information.

Most data is validated, e.g. the same data must be received twice before it is accepted as a new value.

7.1   Programme Identification code

The PI code is invisible for the user. It is used to check whether the correct station is received after a preset is selected, or when the AF follow mechanism switches to an alternative frequency.

When a station is stored in NVM, also its PI code is stored. When the same preset is selected again, the radio verifies the PI code. If the PI code is not correct, and AF follow mode is on, the radio will search for a station with the right PI code, first by scanning all available alternative frequencies, then if after a timeout of 6 seconds the PI code is still not correct, a search tuning operation is started.

During AST Search, the PI code is used to avoid that the same programme is stored at different presets, when it can be received on more than one frequency. For USA application (RBDS) the regional function will only work for PI codes above $B000_{hex}$. PI codes below $B000_{hex}$ do not have regional variants. AF switching is only allowed to stations with exactly the same PI code.

7.2   Programme Service name

By default, the radio will display the received Programme Service name as soon as it is available. The PS name is stored in the preset memory locations. The name is then immediately displayed when a preset station is selected.

Tuning frequency instead of PS name is displayed when the radio is in manual tuning mode. Also, by means of the display key, the radio can be forced to display PTY code, frequency and PS name respectively.

7.3   Programme TYpe

PTY is a code for the kind of programme that is broadcast. Figure 17 shows the names of PTY codes that are defined for RDS. CCR612 can display the PTY currently received, and it can search for a station with a specific PTY code. The user can select a PTY code and start a scan for a station transmitting this PTY code.

7.4   Traffic Announcements

RDS data contains two bits called TP (Traffic Programme) and TA (Traffic Announcement), see the table below for the meaning of these bits.

TP	TA	Meaning
0	0	No announcements, no traffic station
0	1	Traffic announcements indirect via at least one EON referenced station, (traffic station)
1	0	Traffic announcements on this station, (traffic station)
1	1	Traffic announcement on this station now

The radio will start a search for a traffic station when the TA mode is switched on when the current station is not a traffic station.

If TA mode is on, and the current station is not a traffic station, the TP icon will blink, and a warning bleep is generated every 30 seconds.

If a traffic announcement is received while TA mode is on, and the radio is in CD-changer, cassette mode, external mode or muted, this mode is temporarily overruled and the traffic announcement is passed on. If the volume setting was very low, it is temporarily raised to get the user's attention.

If a traffic announcement is received via EON (RDS group 14B is received indicating the PI code of the other station transmitting the traffic announcement), the radio will check its internal pool store and will try to switch over to the other station transmitting the traffic announcement. The radio will stay on this other station for at least 4 seconds to give the broadcaster time to synchronise the RDS TP and TA data over its network.

By pressing the TA key the current traffic announcement will be cancelled but the radio remains in TA mode.

If during a traffic announcement the signal quality becomes too weak resulting in the fact that RDS reception is lost, CCR612 will cancel the traffic announcement after a timeout of 2 minutes.

7.5   Alternative Frequency following

The radio will always assemble a list of alternative frequencies from the received RDS data, even when AF follow mode is off. When the current frequency is left (by tuning, band switching or by turning the radio off), the alternative frequency list is stored in NVM if it is different from the previous stored list.

When AF follow mode is on, the next actions are taken:

1. When selecting a preset, the radio will load the AF list from NVM, and measure the signal strength of the primary frequency and all alternative frequencies. It will then select the strongest station with the correct PI code, before the radio is de-muted.
   (PI codes are compared with the value stored in the preset data in NVM.)
   If no station with the correct PI code is found, after 6 seconds the radio will start a search tuning for a station with the correct PI code. If still not found, it will accept the new station, but it will <u>not</u> update the PI code stored in NVM.
   Search tuning can be cancelled by switching AF follow mode off or by pressing the AUTO / MANUAL key. The radio will then return to the original frequency.

2. At regular intervals - depending on the signal strength of the current station - the signal strength of alternative frequencies is measured. The interval varies from appr. 80 seconds when the signal level of the current station is very strong to appr. 3 seconds when it is very weak.

3. When for a certain time an AF is stronger than the current frequency, or when the current frequency becomes suddenly unacceptable e.g. due to multipath, the radio switches to the best alternative frequency.
   When the programme service is left (by tuning, band switching or by turning the radio off), the new frequency is stored in NVM as the primary frequency for that preset.

   The AF follow algorithm has provisions for special circumstances such as:

   - Mountains and buildings. All signal strengths vary rapidly due to multipath distortion. Switch when the multipath distortion level becomes unacceptable.
   - Loss of RDS data or station changes PI code. Select an alternative frequency with correct PI code.

   The "quality" of a station is a value that is based on signal level as well as multipath level read from the TEA6822 by means of the I^{2}C-bus.

7.6   EON preset update

When the tuned station transmits EON information, the alternative frequencies stored for the station presets are updated via EON. Only those alternative frequency lists of station presets can be updated whose PI codes match one of the PI codes transmitted via EON. Whether or not regional variants of the PI code are taken into account depends on the status of the regional selection. If the regional selection is switched on, the transmitted PI code must exactly match the PI code to update.

If after travelling any distance while tuned to a programme service, a user selects a preset for another station which is cross-referenced by EON-information, CCR612 has to find an acceptable frequency for the new selected station in the new area, without resorting to a PI search. This should occur regardless of the distance travelled, assuming of course that the station is transmitted in the new area.

APPENDIX I NVM layout and initialisation

Words (16 bits) are stored with the most significant byte first (in lowest address).

Ordering of the bits in a byte or word:
    Bit 0 is the least significant (rightmost) bit
    Bit 7 is the most significant (leftmost) bit of a byte
    Bit 15 is the most significant (leftmost) bit of a word

Layout of NVM

sub address	function	meaning / encoding		
00	Checksum	Checksum of two NVM check code bytes: NVM check code byte(0) + NVM check code byte(1) + 2		
01	Volume	00H = mute, 01H = -61 dB		3CH = +20 dB
02	Bass	00H = -15 dB 00H = -18 dB	0AH = mid-range 0AH = mid-range	14H = +15 dB(6320/2) 14H = +18 dB(6321/3)
03	Treble	00H = -12 dB	08H = mid-range	10H = +12 dB
04	Balance	00H = right muted 01H = right -30 dB	09H = mid range	11H = left -30 dB 12h = left muted
05	Fader	00H = front muted 01H = front -30 dB	09H = mid range	11H = rear -30 dB 12H = rear muted
06	system status	bit 0 0 = radio mode bit 1 0 = not cassette mode bit 2 0 = external plug in bit 3 0 = tape in drive bit 4 0 = Dolby off bit 5 0 = AMS off bit 6 0 = Me/Cr off bit 7 0 , not used	1 = external mode 1 = cassette mode 1 = external plug not in 1 = tape not in drive 1 = Dolby on 1 = AMS on 1 = Me/Cr on	
07	system status	bit 0 0 = loudness off bit 1 0 = 2-speakers bit 2 0, not used bit 3 0 = TA mode off bit 4 0 = Regional mode off bit 5 0 = PTY mode off bit 6 0 = no CD-changer bit 7 0 = no External source	1 = loudness on 1 = 4-speakers 1 = TA mode on 1 = Regional mode on 1 = PTY mode on 1 = CD-changer mode 1 = External source mode	

Layout of NVM

sub address	function	meaning / encoding		
08	system status	bit 0/1/2 Band		000 = FM1
				001 = FM2
				010 = FM-AST
				011 = MW
				100 = MW-AST
				101 = LW
				110 = SW
		bit 3 0 = NV PS name is not ok 1 = NV PS name is ok		
		bit 4,5,6 TA volume level 6 5 4		
			- 8 dB	0 0 0
			- 6 dB	0 0 1
			- 4 dB	0 1 0
			-12 dB	0 1 1
			-10 dB	1 0 0
		7 Unused		
09 - 0A	NVM check code	BCD encoded (1 nibble per digit). Most significant digit in leftmost position		
0B - 0E	presets	0B high nibble FM1	low nibble FM2	
		0C high nibble FM-AST	low nibble MW	
		0D high nibble MW-AST	low nibble LW	
		0E SW		
		Each nibble: 1-6 last used preset		
		0 not in preset mode		
0F - 38	PI codes	0F - 1C FM-1		
		1D - 2A FM-2		
		2B - 38 FM-AST		
		For each band: 00,01	PI code for manual/search tuned frequency	
		02,03	PI code for preset-1	
		....		
		0C,0D	PI code for preset-6	

Layout of NVM

sub address	function	meaning / encoding		
39 - F5	AF lists	39 - 77 FM-1 78 - B6 FM-2 B7 - F5 FM-AST		
		For each band:	00 - 08	AF list for manual/search tuned frequency
			09 - 11	AF list for preset-1
			....	
			36 - 3E	AF list for preset-6
F6 - 157	Preset Frequencies	0F6 - 103 FM-1 104 - 111 FM-2 112 - 11F FM-AST 120 - 12D MW 12E - 13B MW-AST 13C - 149 LW 14A - 157 SW		
		For each band:	00,01	manual/search tuned frequency
			02,03	frequency for preset-1
			....	
			0C,0D	frequency for preset-6
		Encoding of frequency: FM: freq = (<value> * 50 kHz) + 87.5 MHz bit 15 of each frequency word contains follow mode bit MW: freq = (<value> * 1 kHz) + 522 kHz LW: freq = (<value> * 1 kHz) + 144 kHz SW: freq = (<value> * 1 kHz) + 5.9 MHz		
158 - 1FF	PS names	158 - 18F FM-1 190 - 1C7 FM-2 1C8 - 1FF FM-AST		
		For each band:	00..07	PS name for manual/search tuned frequency
			08..0F	PS name for preset-1
			....	
			30..37	PS name for preset-6

NVM initialisation values

sub address	function	meaning / encoding
00	Checksum	02H, Checksum (0 + 0 + 2)
01	Volume	1DH, Maximal switch on volume
02	Bass	0AH = mid-range
03	Treble	08H = mid-range
04	Balance	09H = mid-range
05	Fader	09H = mid-range
06	system status	0CH bit 0,1　0 = radio mode bit 2　　1 = external plug not in bit 3　　1 = tape not in drive bit 4　　0 = Dolby off bit 5　　0 = AMS off bit 6　　0 = Me/Cr off bit 7　　0 ,not used
07	system status	00H bit 0　　0 = loudness off bit 1　　0 = 2-speakers bit 2　　0 , not used bit 3　　0 = TA mode off bit 4　　0 = Regional mode off bit 5　　0 = PTY mode off bit 6　　0 = no CD-changer mode bit 7　　0 = no external plug mode
08	system status	00H bit 0/1/2　Band　　　　000 = FM1 bit 3　　　1 = NV PS name is ok bit 4/5/6　TA level -8dB = 000
09 - 0A	security code	00H, 00H, Set to '0000'
0B - 0E	presets	00H, for each band and preset nr 0 is selected
0F - 38	PI codes	00H, for each band and preset PI code is 0000
39 - F5	AF lists	00H, for each band and preset AF list is filled with 00

NVM initialisation values

sub address	function	meaning / encoding
F6 - 157	Preset Frequencies	00H for each band and preset Frequency is 0000 FM = 87.5 MHz MW = 522 KHz LW = 144 KHz SW = 5.9 MHz
158 - 1FF	PS names	00H, for each band and preset PS Name is 00 (No PS Name)

User Manual of High-End RDS/EON
Car Radio System CCR612 (V0.3)

Application Note
96029

APPENDIX II Segment addresses for 143 segment display

Segment addresses for the used (143) segments. Note that BP0 and BP3 are swapped.

PCF8576 pin	Segment line	BP3	BP1	BP2	BP0
LCD pin	Segment line	BP0	BP1	BP2	BP3
1	S0	.	.	REG	EON
2	S1	1E	1I	1F	1P
3	S2	1C	1B	1L	AST
4	S3	.	2E	2F	SCAN
5	S4	2N	2J	2L	LOC
6	S5	.	2C	2B	AF
7	S6	3E	3I	3F	3P
8	S7	3C	3B	3L	TP
9	S8	.	4E	4F	.
10	S9	4N	4J	4L	ST
11	S10	.	4C	4B	.
12	S11	5E	5I	5F	5P
13	S12	5C	5B	5L	TA
14	S13	.	6E	6F	PTY
15	S14	6N	6J	6L	.
16	S15	6C	DP(= P2)	6B	.
17	S16	7N	7J	7B	.
18	S17	.	7C	8F	.
19	S18	8E	8I	8K	8P
20	S19	.	8C	8B	.
21	S20	9C	9G	9B	LOUD
22	S21	CLIP	AMS	MTL	[)(]
23	S22	9D	9E	9F	9A
24	S23	8D	8N	8J	8L
25	S24	8M	8H	8G	8A
26	S25	7D	7H	7L	7G
27	S26	7M	7I	7K	7A

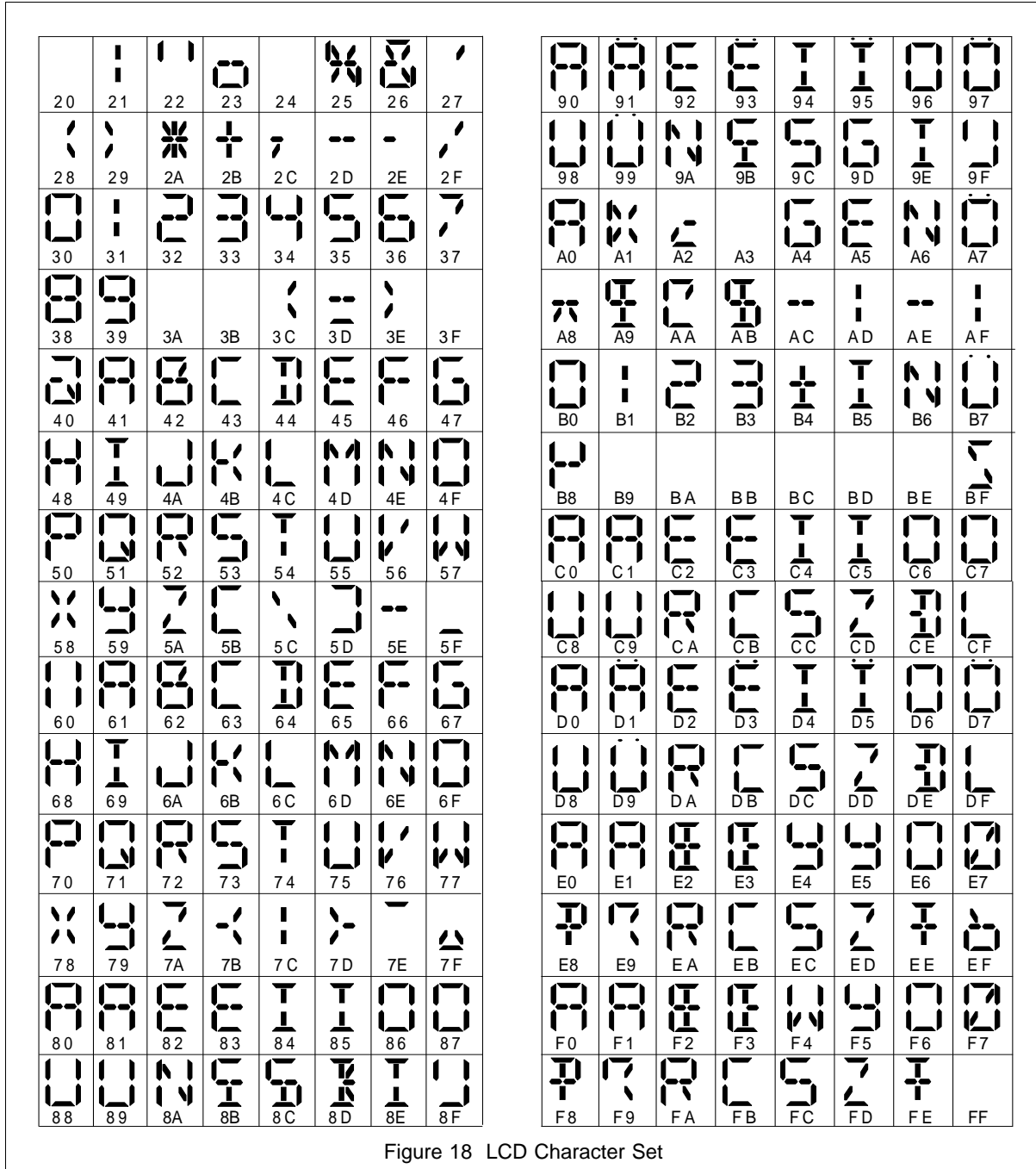| PCF8576 pin	Segment line	BP3	BP1	BP2	BP0
LCD pin	Segment line	BP0	BP1	BP2	BP3
28	S27	7E	7F	.	7P
29	S28	6D	6H	6G	6A
30	S29	6M	6I	6K	6P
31	S30	5D	5N	5J	5G
32	S31	5M	5H	5K	5A
33	S32	4D	4H	4G	4A
34	S33	4M	4I	4K	4P
35	S34	3D	3N	3J	3G
36	S35	3M	3H	3K	3A
37	S36	2D	2H	2G	2A
38	S37	2M	2I	2K	2P
39	S38	1D	1N	1J	1G
40	S39	1M	1H	1K	1A
41		BP0			
42			BP1		
43				BP2	
44					BP3

APPENDIX III LCD Display Character Set.

Figure 18 LCD Character Set

APPENDIX IV CIRCUIT DIAGRAMS

dummy page for MAIN BOARD PART 1A

dummy page for MAIN BOARD PART 1B

dummy page for MAIN BOARD PART 1C

dummy page for MAIN BOARD PART 2A

dummy page for MAIN BOARD PART 2B

dummy page for MAIN BOARD PART 3

dummy page for FRONT BOARD PART FP-1A

dummy page for FRONT BOARD PART FP-1B

dummy page for ICE MODULE EURO 1

dummy page for CCR612 mainboard pcb top

dummy page for CCR612 mainboard pcb bottom

dummy page for ICE module pcb

dummy page for front panel top

dummy page for SUB BOARD PACS