

Application Note

I C s f o r C a r R a d i o

Outline Specification of High-End RDS/EON Car Radio System CCR520S V2.5

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This Outline Specification is valid for CCR520S software release V2.5.

Modifications with respect to the application note "Outline Specification of Computer Controlled Car Radio System CCR520S V2.0", report number AN95033 :

1. NVM Initialization added.
2. Clock with synchronisation to RDS added

Modifications with respect to the application note "Outline Specification of Computer Controlled Car Radio System CCR520S V1.5", report number ERA/AN93008 :

1. USA option added for RBDS and USA band limits / tuning grid.
2. Allow AF-switching to Supra-regional transmitters for RDS.
3. PTY functionality.
4. During AST running frequency is not displayed anymore.
5. The TA / PTY Alarm volume level is programmable.
6. Improved RDS decoding and AF switching behaviour especially with respect to multipath.
7. Improved EON preset update.

SUMMARY:

CCR520 is a computer controlled high-end AM/FM car radio system with RDS/RBDS decoding. It is based on a single 8051 family microcontroller (P83CE528) and various I²C-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, clock function and a detachable front.

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

"The purchase of Philips' complete set of Integrated Circuits as specified in this Outline Specification for manufacture of a radio system conforming the relevant specification as herein given, secures immunity from suit on unauthorized use of those Philips' patent rights, which specifically relate to automatic broadcast station storage (AST) and/or radio data system (RDS) features."



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1 INTRODUCTION

CCR520S is a computer controlled system based on a P83CE528 microcontroller. It controls a high-end AM/FM car radio with RDS (Radio Data System) or RBDS (Radio Broadcast Data System) and EON (Enhanced Other Networks information) and various I²C-bus controlled peripherals.

The main features are:

- Radio control and RDS/RBDS decoding in a single microcontroller.
- Bands: FM, MW, LW. (Factory selectable FM only / LW disable)
- Tuning: manual, automatic (search and scan), Automatic Store Tuning (AST), selectable tuning grid and band limits for different parts of the world (Europe/USA option).
- Presets: 18 FM, 12 MW, 6 LW.
- External audio jack for e.g. CD player.
- Controls power stabilizer IC.
- PLL frequency synthesizer.
- Sound control: volume, bass, treble, balance, fader, loudness and mute via I²C-bus or potentiometers.
- RDS/RBDS functions:
 - PS Programme Service name display and storage in Non Volatile Memory;
 - PTY Programme TYpe display and searching;
 - TP/TA Traffic Announcements break-in;
 - AF/PI Alternative Frequency follow and storage in Non Volatile Memory;
 - EON Enhanced Other Networks traffic announcements and update of preset AF lists in NVM.
 - TIME Time information extraction for clock function.
- Security code:
 - enable/disable by the user;
 - preprogrammable in the factory by means of a service mode.
- Non Volatile Memory for: programme presets;
RDS/RBDS information;
System status.
- LCD display with 120 or 144 segments.
- Keyboard optionally detachable with up to 27 key functions.
- Clock function

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 specified otherwise.

2 BASIC HARDWARE CONFIGURATION

The basic configuration of the computer controlled car radio system CCR520 is given in the figures below.

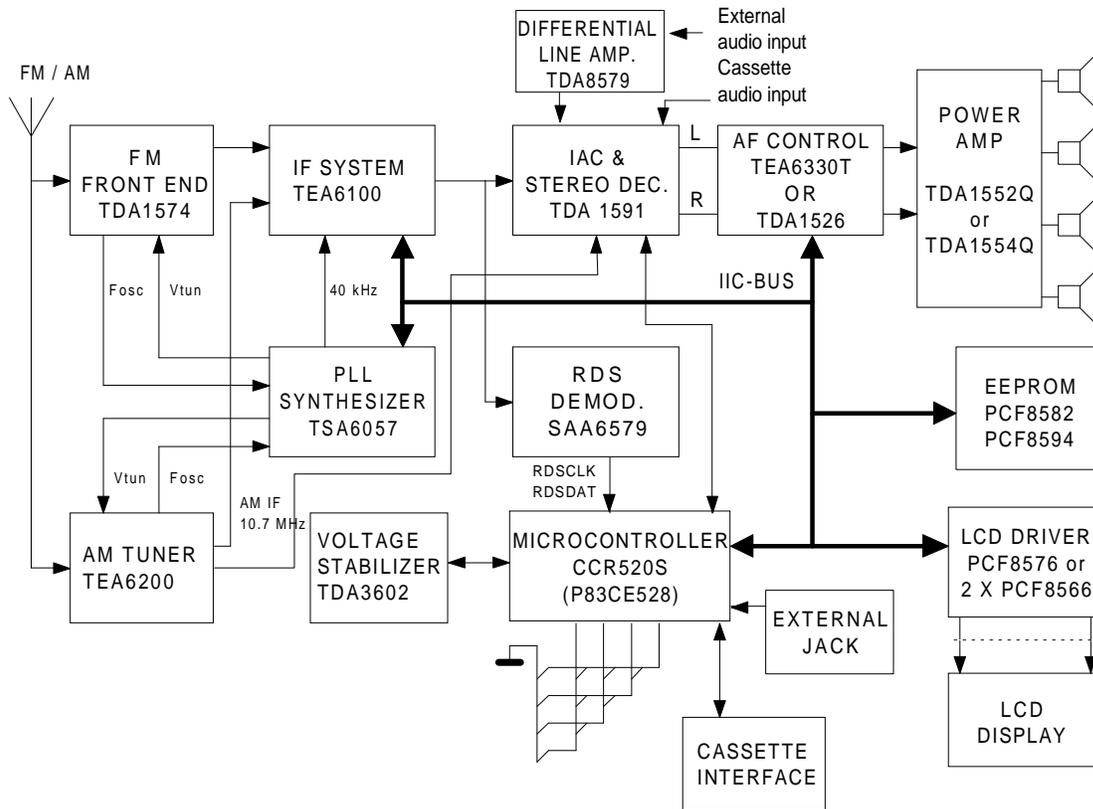


Figure 1 Block diagram of CCR520 with fixed keyboard

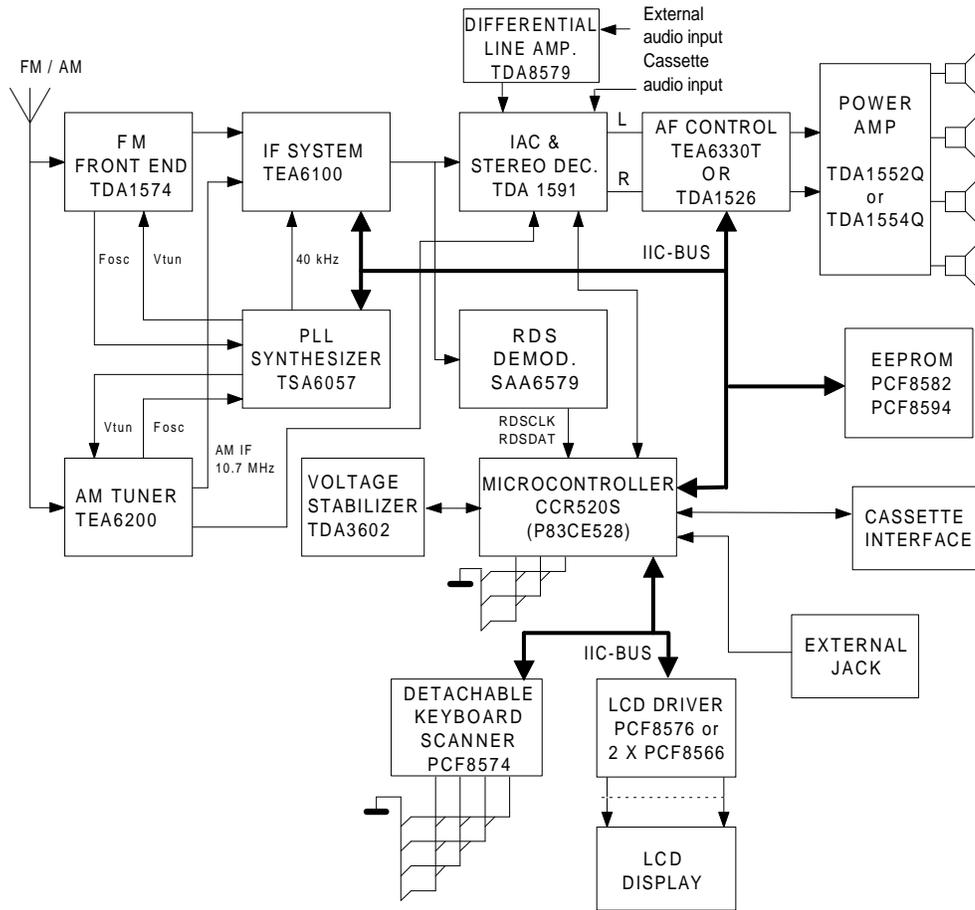


Figure 2 Block diagram of CCR520 with detachable keyboard

The CCR520 concept requires the next IC's to be present in the system:

- TDA1574(T) Performs all the FM front-end functions, except the R.F. pre-amplifier stage. Incorporates an FM/IF pre-amplifier.
- TEA6200 AM tuner, up-conversion system. Does not need an aerial tuned circuit. I.F. frequency 10.7 MHz. No alignments needed.
- TEA6100 Integrated FM/IF system including a digital AM/FM tuning interface for microcomputer controlled radios with an I²C-bus.
- TSA6057(T) PLL synthesizer with separate prescalers for AM and FM and loop filter outputs. I²C-bus controlled.
- TDA1591(T) System combination of adjustment free PLL stereo decoder with de-emphasis control and an Interference Absorption Circuit (IAC) with low component count. Specially designed for car radios.
- TEA6330T or I²C-bus (TEA6330) or potentiometer (TDA1526) controlled AF pre-amplifier
- TDA1526 for car and home receivers. Includes volume, bass, treble, balance, fader (TEA6330) control and mute (TEA6330).
- CCR520S The microcontroller, based on a P83CE528EFB. It is a 8051 derivative with an 8-bit CPU, 32 Kbytes ROM, 512 bytes RAM and four 8-bits I/O ports in a 44-pin QFP package.
- TDA3602 Supply voltage stabilizer in SIL package with three output voltages (2 x 5V and 8.5V). Two outputs are switchable by external controls.
- TDA1552Q Class-B audio power amplifiers in SIL plastic package with 4 identical amplifiers.
TDA1554Q The TDA1552Q can deliver 2 x 22 W in BTL configuration, the TDA1554Q can deliver either 4 x 11 W or 2 X 22 W.
- SAA6579(T) RDS demodulator with onboard 57 kHz bandpass filter and a digital demodulator. Outputs a digital data signal and a clock signal for further processing.
- PCF8566T LCD display drivers that interface to almost any liquid crystal display (LCD)
PCF8576T having low multiplex rates. They generate the drive signals for any static or multiplexed LCD with up to four backplanes and up to 24 (PCF8566) or 40 (PCF8676) segment lines and can easily be cascaded for larger LCD applications. I²C-bus controlled.
- PCF8582/94E-2P/T 256/512 byte 5V electrically erasable programmable read only memories (EEPROM) that can be 100,000 times re-written.
- PCF8574(T) Detachable Keyboard Scanner. I²C-bus controlled.
- TDA8579(T) Differential Line Amplifier for external input.

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 (1 / 9 kHz steps)	}	For application in Europe
LW: 144 - 288 kHz (1 kHz steps)	}	
FM: 87.90 - 107.90 MHz (100 / 200 kHz steps)	}	For application in USA
AM: 530 - 1710 kHz (1 / 10 kHz steps)	}	

- PLL tuning principle.
- Manual tuning up / down.
Initially slow pace / fine grid. After 2.5 sec. fast pace / coarse grid.
- Local/DX switch.
The local/DX feature controls the search sensitivity. If the FM tuner has a tuner attenuator, the local/DX switch controls the attenuator during search. If not, it controls the signal level threshold during search. Default after switching on is always DX mode.
- Automatic 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. Automatic muting and display of running frequency.
- 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 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, 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 recalled/stored by two key control (up and down) or by 6 separate preset keys.

- AF follow mode.
If AF follow mode is on, the set will regularly measure the signal strength on 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 NVM are examined. The frequency with the highest signal strength that broadcasts the correct PI code will be selected. Only when the programme is not found on one of the AFs, a search is started after 6 seconds for a station with the proper PI code.
- TA mode.
In TA mode the radio only searches for traffic stations. These are stations that may transmit (EON) traffic announcements.
The radio will automatically start a search when switching TA mode on and the current station is not a traffic station.
- PTY search mode.
In PTY search mode the radio only searches for transmitters that transmit a user-selected PTY code.
Dependent on the factory option USA/Europe the RBDS PTY-table or the RDS PTY-table is used.
- Last status memory: frequency, PI code, PS Name, AF lists and AF follow mode on/off status are stored in memory for each preset in each band. This status is recalled during preset switch, band switch and switch on.

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

- Data decoding and collection of:
 - PI, Programme Identification code;
 - AF, Alternative Frequencies;
 - TP, Traffic Programme;
 - TA, Traffic Announcement;
 - PS, Programme Service name;
 - PTY, Programme TYPe;
 - EON, Enhanced Other Networks information;
 - TIME, Time information.
- 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 and regional mode status.

- 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 or Supra-regional code. When regional mode is off, the radio will also switch over to stations broadcasting regional variants of the original PI-code. (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} don't have regional variants. (AF-switching is only allowed to stations with exactly the same PI code).
- Break-in of traffic announcements and PTY alarm messages when the radio is muted or in Cassette / External mode.

- EON:
- Temporally switch to an other station if EON information indicates a traffic announcement on that other station even when the radio is muted or in Cassette / External mode.
 - Update lists of alternative frequencies of other stations stored in preset memory with information received via EON.

Detachable front:

- Optionally, the keyboard and the LCD display unit can be placed on a detachable front, controlled by a 2nd I²C 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.

- Control: - Up to 27 local control keys on either a fixed, a detachable keyboard or a combination.

- Clock : - A twenty four hour clock can be displayed if RDS time information has been received.

- Display: - 120 Segment LCD or 144 Segment LCD with Umlaut (ü) and Accent (á) characters, 1:3 multiplexed.

- 8 Alphanumeric characters + decimal point are used for display of:
 - Band and frequency (Example: "FM 103.50")
 - Indication "BALANCE", "FADER", "TREBLE", "BASS" and their position (either analog bar or digital)
 - The security code being entered
 - 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.
 - Clock display can be: " 08.12" or " --.--" if not yet synchronised to RDS clock.
- 7 Segment display for the current programme preset number.

- 8 Icons for display of:
 - STEREO On when stereo pilot signal is detected, off when forced mono is selected or no stereo pilot signal is detected.
 - AST On when AST band selected.
 - AF On when AF follow mode is enabled (see also Tuning). Flashes 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 PTY code received, flashing during PTY search.
 - DOLBY  On in cassette mode when dolby selected.
 - ME/CR On in cassette mode when ME/CR selected.

Non Volatile Memory:

Either 256 or 512 bytes. The amount of memory determines the maximum number of alternative frequencies to be stored per preset (5/9 AF's for 256/512 bytes EEPROM).

The next information is stored in NVM:

- Checksum to verify whether an EEPROM has been initialized or not. If a not initialized EEPROM has been detected default values will be stored to insure reasonable settings for e.g. the audio control values.
- System status e.g.: band, audio source (radio / cassette / external).
- User programmable options.
- For each band (FM1, FM2, FM-AST, MW1, MW-AST, LW): six preset frequencies and one non-preset frequency, last used preset.
- For each stored FM frequency:
 - PI-code
 - PS Name (512 byte EEPROM only)
 - AF List (9 AF's maximum, 5 AF's for 256 byte EEPROM)
 - AF follow mode on/off.
- Audio controls: volume, bass, treble, fader, balance and loudness.
- Four digit security code (0000 - 9999).
 - Security code can be preprogrammed with the keyboard by means of a service mode, or a preprogrammed EEPROM has to be used.
 - Security code can not be changed by the user. The security code can be enabled or disabled by the user; enable/disable status is stored in NVM.
 - If enabled, the security code must be entered each time the main supply line has been interrupted or the radio has been removed from the retrack.

External audio input:

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

Sound:

- Volume, balance, fader, treble and bass control with vol-up/down keys.
- Analog control select key to cycle through balance, fader, treble and bass.
- Mute key
- Automatic muting during tuning and AST search (silent tuning).
- Break-in of traffic announcements (in TA mode) and PTY-alarm messages when the radio is muted or in cassette / external mode. The volume level during a TA / PTY message can be installed to one of 5 fixed by means of the user programmable options.
- Loudness switching.
- 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.

Power-amplifier:

- Conventional power-amplifiers can be used such as two TDA1552Q (4 x 22 Watt), one TDA1554Q (4 x 11 Watt (2 Ω load) or 6 Watt (4 Ω load)) or one TDA1552Q (2 x 22 Watt (4 Ω load)) in a BTL stereo configuration.

Options: Diode programmable

- Detachable front
- No LW band
- FM only
- No security code
- Static on/off switch
- Method of source switching
- Application area of the radio (USA/Europe)

User programmable

- 2 / 4 Loudspeakers
- Loudness on/off
- Bar / digital sound control display
- TA / PTY Alarm volume level
- Security code enable/disable

Automatically detected

- Digital sound control chip or conventional controls
- 120 / 144 segment LCD display
- 256 or 512 bytes EEPROM
- Loudness
- Local/DX FM Tuner Control
- AMS)
- Dolby) Cassette deck functions
- ME/CR)

Power connections:

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

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 off).
- Switch off by:
 - Power key, can be static or momentary.
 - Ignition contact.
 - Removal of detachable keyboard.
 - Opening of the security contact.
 - Wrong security code entered (after 30 to 40 seconds).
- 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.

- Cassette:
- Automatically switches to cassette mode after insertion of a cassette
 - Interfaces with a mechanically controlled cassette deck
 - Play/wind mode detection
 - Play direction detection for auto-reverse cassette decks
 - Radio reception during wind mode
 - Cassette/Radio mode key
 - Metal/Chromium tape on/off key
 - DOLBY system on/off key
 - AMS (Auto Music Search) on/off key
 - Optional source switching to external mode (cd plug is in) or always to radio mode (option diode D6 is in) when the cassette is ejected.

4 TARGET CHARACTERISTICS OF THE RADIO

General

Supply voltage range		10.2	to	16	V
Quiescent current,	power off			2	mA (typ.)
	power on			520	mA (typ.)
Operating ambient temperature		-30	to	75	°C
FM frequency range	Europe	87.5	to	108	MHz
	USA	87.9	to	107.9	MHz
AM frequency range	Europe	144	to	288	kHz (LW)
		531	to	1629	kHz (MW)
	USA	530	to	1710	kHz (MW)
IF-frequency (AM and FM)				10.7	MHz

FM characteristics

$V_{\text{supply}} = 14.4 \text{ V}$,
 $T_{\text{amb}} = 25 \text{ °C}$,
 $f_o = 98 \text{ MHz}$,
 $f_{\text{dev}} = 22.5 \text{ kHz}$,
 $f_{\text{mod}} = 1 \text{ kHz}$ unless otherwise specified.
 Dummy aerial as shown in Figure 3.

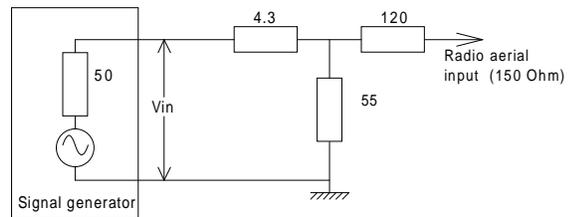


Figure 3 Dummy aerial to test the FM mode

Aerial input voltage (V_{in}), for -3 dB limiting ($f_{\text{mod}} = 400 \text{ Hz}$)		10		μV
for $(S+N)/N = 26 \text{ dB}$		3		μV
for 10 dB crosstalk (stereo)		150		μV
Signal-to-noise ratio over most of the signal range		60		dB
RF signal handling capability for THD < 2% at 75kHz dev.		> 2		V
AF output over most of the signal range				
measured at pin 11 of IF module TEA6100.		150		mV
AM suppression over most of the signal range		> 50		dB
Total Harmonic Distortion over most of the signal range. 75 kHz dev.		0.5		% (typ.)
Adjacent signal selectivity (two signal method) S_{200}		> 44		dB
IF bandwidth 3dB bandwidth		160		kHz
IF suppression		> 85		dB
Search sensitivity		V_{in}	> 20	μV
RDS sensitivity:	Traffic Announcement	V_{in}	> 14	μV
	PService Name	V_{in}	> 16	μV
IF counter resolution			6.4	kHz
Frequency grid	Search Tuning		100	kHz
	Manual Tuning	Europe	50	kHz
		USA	100	kHz

AM characteristics

$V_{\text{supply}} = 14.4 \text{ V}$,
 $T_{\text{amb}} = 25 \text{ }^\circ\text{C}$,
 $f_o = 999 \text{ kHz}$,
 $m = 0.3$,
 $f_{\text{mod}} = 1 \text{ kHz}$ unless otherwise specified.
 Dummy aerial as shown in Figure 4.

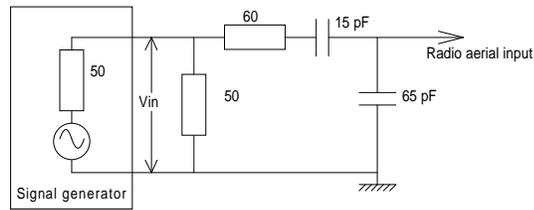


Figure 4 Dummy aerial to test the AM mode

Aerial input voltage (V_{in}), for $(S+N)/N = 26 \text{ dB}$	MW	45	μV
	LW	70	μV
Signal-to-noise ratio for $V_{\text{in}} = 1 \text{ mV}$		> 45	dB
AGC range $V_{\text{in}}/500 \text{ mW}$ for 10 dB variation of AF output		90	dB
RF signal handling capability for THD < 10 % at $m = 0.8$		1.4	V
Total Harmonic Distortion over most of the AGC range, $m = 0.8$, $f_{\text{mod}} = 400 \text{ Hz}$		< 2	%
Total bandwidth B 3dB		5	kHz
Fidelity (-3 dB)		30 Hz - 2	kHz
IF suppression tuned frequency 1400 kHz, $V_{\text{in}} = 20 \mu\text{V}$		62	dB
Image rejection tuned frequency 1400 kHz, $V_{\text{in}} = 20 \mu\text{V}$		76	dB
IF selectivity	S_9	36	dB
	S_{20}	66	dB
IF counter resolution		500	Hz
Frequency grid,			
LW (search and manual tuning)		1	kHz
MW (search tuning) Europe		9	kHz
MW (manual tuning)		1	kHz
MW (search tuning) USA		10	kHz
MW (manual tuning)		1	kHz
Search sensitivity	V_{in}	> 45	μV

5 MICROCONTROLLER AND PIN ASSIGNMENTS

CCR520S is based on a P83CE528 microcontroller. It is single-chip microcontroller, manufactured in an advanced CMOS process and is a derivative of the 80C51 microcontroller family.

The pin assignments for CCR520S are given in Figure 5 and Figure 7.

Figure 6 and Figure 8 show the keyboard configurations for the fixed and detachable front respectively.

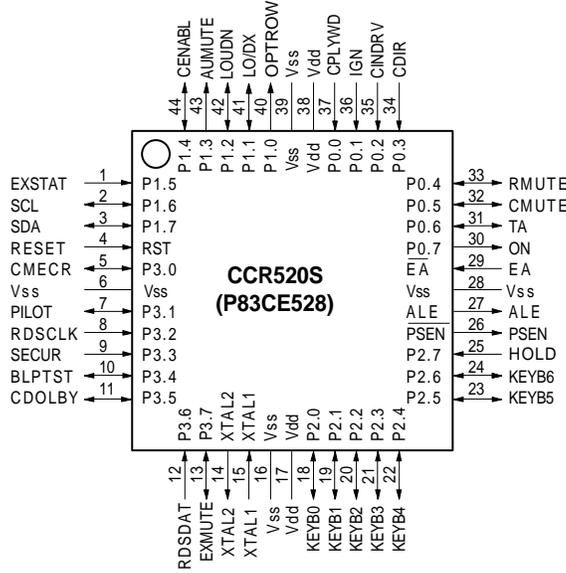


Figure 5 Pinning of CCR520S for fixed front

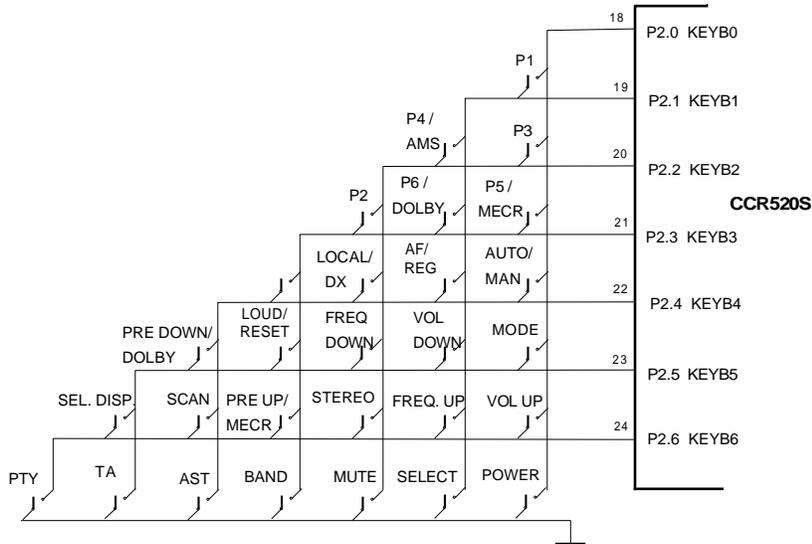


Figure 6 Keyboard configuration for fixed front

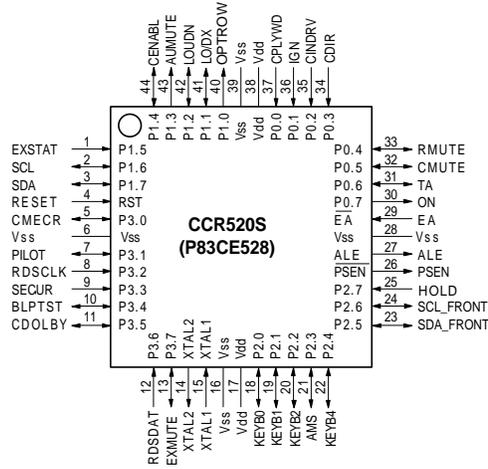


Figure 7 Pinning of CCR520S for detachable front

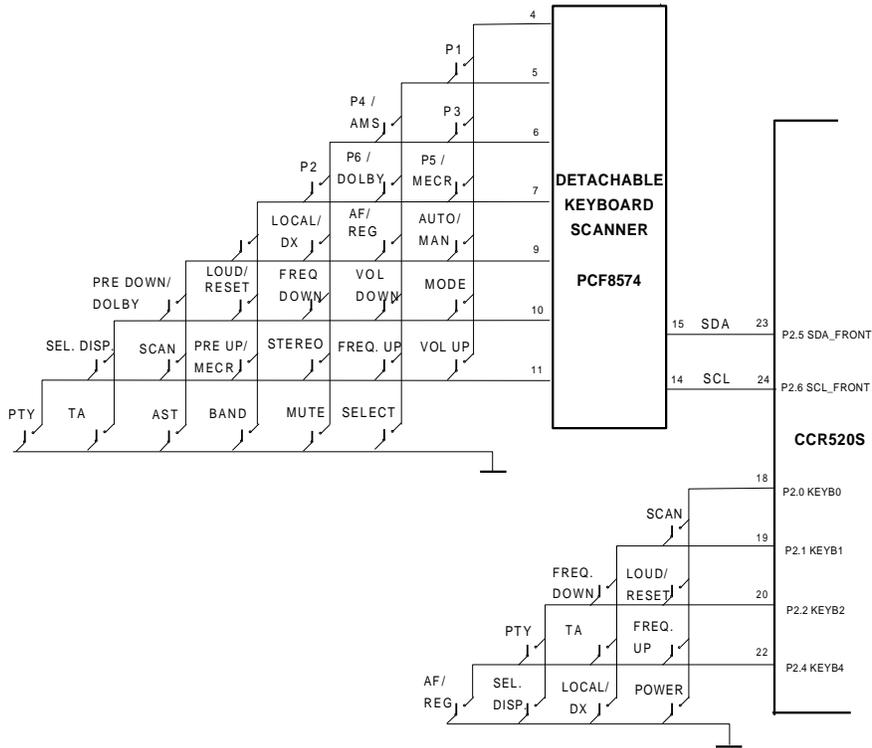


Figure 8 Keyboard configuration for detachable front

When the detachable keyboard option is chosen it is not necessary to use all the keys in the small fixed keyboard. At least the power key should be mounted when is chosen for the momentary on/off key. (Static on/off switch option disabled)

The following table gives a short description of all pins.

PIN	NAME	I/O	DESCRIPTION
1	EXSTAT	I	Status of external audio jack
2	SCL	I/O	I ² C Bus Clock line
3	SDA	I/O	I ² C Bus Data line
4	RESET	I	Device reset
5	CMECR	I/O	Cassette ME/CR select
6+16+28+39	Vss		GROUND
7	PILOT	I/O	Stereo indication / mono/stereo control
8	RDSCLK	I	RDS Clock from RDS demodulator
9	SECUR	I	Security contact
10	BLPTST	I/O	Bleep output / Test input (service mode)
11	CDOLBY	I/O	Cassette dolby select
12	RDSDAT	I	RDS Data from RDS demodulator
13	EXMUTE	O	Mute external audio source
14	XTAL2	O	Oscillator output
15	XTAL1	I	Oscillator input
17+38	Vdd		+ 5 V supply voltage
18	KEYB0	I/O	Keyboard matrix line 0
19	KEYB1	I/O	Keyboard matrix line 1
20	KEYB2	I/O	Keyboard matrix line 2
21	KEYB3	I/O	Keyboard matrix line 3 / AMS select
22	KEYB4	I/O	Keyboard matrix line 4
23	KEYB5	I/O	Keyboard matrix line 5 / detach. I ² C Data
24	KEYB6	I/O	Keyboard matrix line 6 / detach. I ² C Clock
25	HOLD	I	Power supply OK in
26	/PSEN	O	Program Store Enable (n.c.)
27	ALE	O	Address Latch Enable (n.c.) (disabled)
29	/EA	I	External Access (connect pull-up)
30	ON	O	Power supply on control
31	TA	O	Traffic announcement in progress
32	CMUTE	O	Cassette mute
33	RMUTE	O	Radio mute
34	CDIR	I	Cassette direction (forward/reverse)
35	CINDRV	I	Cassette In drive
36	IGN	I	Ignition contact status or static on/off switch
37	CPLYWD	I	Cassette play/wind mode
40	OPTROW	O	Option row output
41	LO/DX	I/O	Local / DX control
42	LOUDN	I/O	Loudness
43	AUMUTE	O	General audio mute
44	CENABL	O	Cassette enable

6 KEYBOARD

The keyboard consists of a 7-line triangular matrix connected to the microcontroller or the I/O expander PCF8574. The following table lists the available keys.

NAME	DESCRIPTION
P 1	Preset-1
P 2	Preset-2
P 3	Preset-3
P 4 / AMS	Preset-4 / Auto Music Search on/off (cassette)
P 5 / ME/CR	Preset-5 / Metal/Chromium on/off (cassette)
P 6 / dolby	Preset-6 / dolby on/off (cassette)
POWER	Power on/off (momentary on/off key)
VOL-UP	Analog sound setting up
VOL-DOWN	Analog sound setting down
SELECT	Select analog function for update
MUTE	Mute on/off
FREQ-UP	Manual / search tuning upward
FREQ-DOWN	Manual / search tuning downward
AUTO/MANUAL	Switch between manual / search tuning
BAND	Cycle through bands
AST	Automatic search tuning band select and programming
AF / REG	RDS AF follow mode on/off / regional mode on/off
TA	RDS traffic information mode on/off
PTY	Display current PTY / enter PTY search mode
LOUD / RESET	Loudness on/off / Sound settings reset
MODE	Radio / cassette / external selection (/when pressed long, display clock)
LOCAL / DX	Local / DX selection
STEREO	Suppress/enable stereo mode
PRE-UP / ME/CR	Programme preset up / Metal/Chromium on/off (cassette)
PRE-DOWN / dolby	Programme preset down / Dolby on/off (cassette)
SCAN	Automatic frequency scan
DISPLAY	Select display (Clock display / PTY / frequency / PS name)

7 OPTION DIODES

Diode	Description
D1	Detachable front
D2	FM Only
D3	No LW band
D4	No security
D5	Static on/off switch
D6	Method of source switching
D7	USA Application

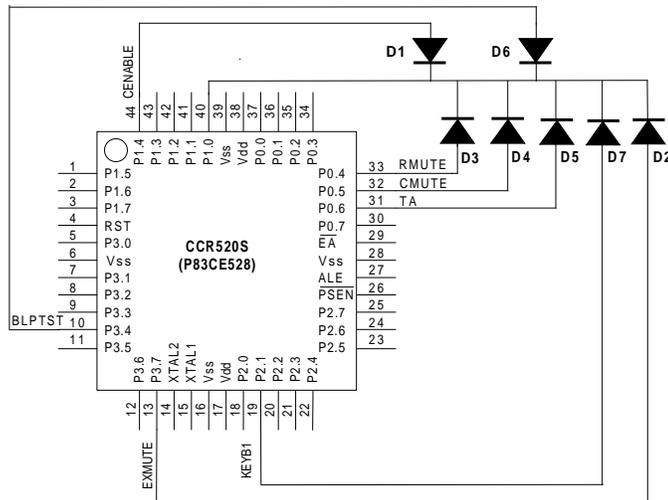


Figure 9 Location of option diodes

8 LCD DISPLAY

The Liquid Crystal Display (LCD) is driven by either one PCF8576 or two PCF8566's. Figure 10 shows all the segments of the display. To support the RDS programme service name (PS) feature, the display is equipped with 8 alpha numeric characters. With 13 segments per character, display is possible of all required RDS characters (capitals only); with 16 segments per character, umlauts and the accent can be displayed as well.

Both displays operate in 1:3 multiplex mode.

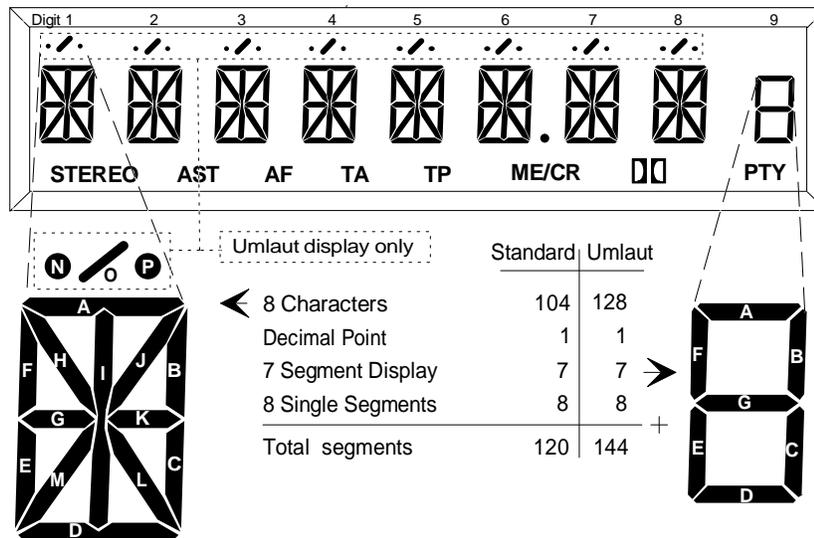


Figure 10 Liquid Crystal Display (LCD) layout