



SANYO Semiconductors

DATA SHEET

An ON Semiconductor Company



LC72720YVS – Single-Chip RDS Signal-Processing System IC

CMOS IC

Overview

The LC72720YVS is a single-chip system IC that implement the signal processing required by the European Broadcasting Union RDS (Radio Data System) standard and by the US NRSC (National Radio System Committee) RBDS (Radio Broadcast Data System) standard. This IC include band-pass filter, demodulator, synchronization, and error correction circuits as well as data buffer RAM on chip and perform effective error correction using a soft-decision error correction technique.

Functions

- Band-pass filter : switched capacitor filter (SCF)
- Demodulator : RDS data clock regeneration and demodulated data reliability information
- Synchronization : Block synchronization detection
(with variable backward and forward protection conditions)
- Error correction : Soft-decision/hard-decision error correction
- Buffer RAM : Adequate for 24 blocks of data (about 500ms) and flag memory
- Data I/O : CCB interface (power on reset)

Features

- Error correction capability improved by soft-decision error correction
- The load on the control microprocessor can be reduced by storing decoded data in the on-chip data buffer RAM.
- Two synchronization detection circuits provide continuous and stable detection of the synchronization.
- Data can be read out starting with the backward-protection block data after a synchronization reset.
- Fully adjustment free

Specifications

- Operating power-supply voltage : 3.0 to 3.6V
- Operating temperature : -40 to +85°C
- Package : SSOP30(275mil)

- CCB is a registered trademark of SANYO Semiconductor Co., Ltd.
- CCB is SANYO Semiconductor's original bus format. All bus addresses are managed by SANYO Semiconductor for this format.

■ Any and all SANYO Semiconductor Co.,Ltd. products described or contained herein are, with regard to "standard application", intended for the use as general electronics equipment. The products mentioned herein shall not be intended for use for any "special application" (medical equipment whose purpose is to sustain life, aerospace instrument, nuclear control device, burning appliances, transportation machine, traffic signal system, safety equipment etc.) that shall require extremely high level of reliability and can directly threaten human lives in case of failure or malfunction of the product or may cause harm to human bodies, nor shall they grant any guarantee thereof. If you should intend to use our products for new introduction or other application different from current conditions on the usage of automotive device, communication device, office equipment, industrial equipment etc. , please consult with us about usage condition (temperature, operation time etc.) prior to the intended use. If there is no consultation or inquiry before the intended use, our customer shall be solely responsible for the use.

■ Specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein stipulate the performance, characteristics, and functions of the described products in the independent state, and are not guarantees of the performance, characteristics, and functions of the described products as mounted in the customer's products or equipment. To verify symptoms and states that cannot be evaluated in an independent device, the customer should always evaluate and test devices mounted in the customer's products or equipment.

SANYO Semiconductor Co., Ltd.

<http://www.sanyosemi.com/en/network/>

LC72720YVS

Specifications

Absolute Maximum Ratings at $T_a = 25^\circ\text{C}$, $V_{\text{SSD}} = V_{\text{SSA}} = 0\text{V}$

Parameter	Symbol	Pin Name	Ratings	Unit
Maximum supply voltage	Vddmax	Vddd, Vdda	-0.3 to +7.0	V
Maximum input voltage	Vin1max	CL, DI, CE, SYR, T1, T2, T3, T4, T5, T6, T7, SYNC	-0.3 to +7.0	V
	Vin2max	XIN	-0.3 to Vddd+0.3	V
	Vin3max	MPXIN, CIN	-0.3 to Vdda+0.3	V
Maximum output voltage	Vo1max	DO, SYNC, RDS-ID, T3, T4, T5, T6, T7	-0.3 to +7.0	V
	Vo2max	XOUT	-0.3 to Vddd+0.3	V
	Vo3max	FLOUT	-0.3 to Vdda+0.3	V
Maximum output current	Io1max	DO, T3, T4, T5, T6, T7	+6.0	mA
	Io2max	XOUT, FLOUT	+3.0	mA
	Io3max	SYNC, RDS-ID	+20.0	mA
Allowable power dissipation	Pdmax	($T_a \leq 85^\circ\text{C}$)	150	mW
Operating temperature	Topr		-40 to +85	$^\circ\text{C}$
Storage temperature	Tstg		-55 to +125	$^\circ\text{C}$

Allowable Operating Ranges at $T_a = -40$ to 85°C , $V_{\text{SSD}} = V_{\text{SSA}} = 0\text{V}$

Parameter	Symbol	Pin Name	Conditions	Ratings			Unit
				min	typ	max	
Supply voltage	Vdd1	Vddd, Vdda		3.0		3.6	V
	Vdd2	Vddd	Serial data hold voltage	2.0			V
Input high-level voltage	V_{IH}	CL, DI, CE, SYR, T1, T2		0.7Vddd		6.5	V
Input low-level voltage	V_{IL}	CL, DI, CE, SYR, T1, T2		0		0.3Vddd	V
Output voltage	V_{O}	DO, SYNC, RDS-ID, T3, T4, T5, T6, T7				6.5	V
Input amplitude	V_{IN1}	MPXIN	$f=57 \pm 2\text{kHz}$			50	mVrms
	V_{IN2}		100% modulation composite	100			mVrms
	V_{XIN}	XIN		400		1500	mVrms
Guaranteed crystal Oscillator frequencies	XTAL	XIN, XOUT	$C_l \leq 120\Omega$ (XS=0)		4.332		MHz
			$C_l \leq 70\Omega$ (XS=1)		8.664		MHz
Crystal oscillator frequency deviation	TXtal	XIN, XOUT	$f_o=4.332\text{MHz}, 8.664\text{MHz}$			± 100	ppm
Data setup time	tSU	DI, CL		0.75			μs
Data hold time	tHD	DI, CL		0.75			μs
Clock low level time	tCL	CL		0.75			μs
Clock high level time	tCH	CL		0.75			μs
CE wait time	tEL	CE, CL		0.75			μs
CE setup time	tES	CE, CL		0.75			μs
CE hold time	tEH	CE, CL		0.75			μs
CE high-level time	tCE	CE				20	ms
Data latch change time	tLC					1.15	μs
Data output time	tDC	DO, CL	Differs depending on the value of the pull-up resistor used.			0.46	μs
	tDH	DO, CE				0.46	μs

LC72720YVS

Electrical Characteristics at $T_a = -40$ to 85°C , $V_{SSD} = V_{SSA} = 0\text{V}$

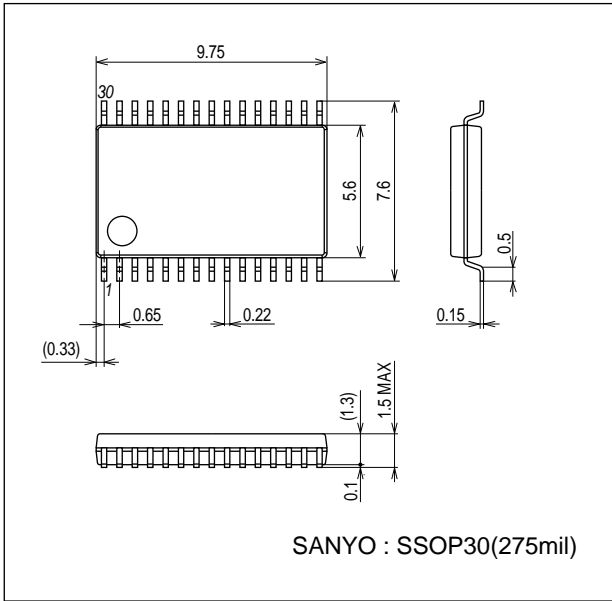
Parameter	Symbol	Pin Name	Conditions	Ratings			Unit
				min	typ	max	
Input resistance	R_{MPXIN}	MPXIN-Vssa	$f=0$ to 100kHz		23		$k\Omega$
Internal feedback resistance	R_f	XIN			1.5		$M\Omega$
Center frequency	f_c	FLOUT		56.5	57.0	57.5	kHz
-3dB band width	BW-3dB	FLOUT		2.5	3.0	3.5	kHz
Gain	Gain	MPXIN-FLOUT	$f=57\text{kHz}$	28	31	34	dB
Stop band Attenuation	Att1	FLOUT	$\Delta f=\pm 7\text{kHz}$	30			dB
	Att2	FLOUT	$f<45\text{kHz}, f>70\text{kHz}$	40			dB
	Att3	FLOUT	$f<20\text{kHz}$	50			dB
Group delay deviation	G-Delay	FLOUT	$f=57\pm 1.2\text{kHz}$			± 2.0	μs
Reference voltage output	V_{ref}	V_{ref}	$V_{DDA}=5.0\text{V}$		1.65		V
Hysteresis	V_{HIS}	CL, DI, CE, SYR, T1, T2			$0.1V_{DDD}$		V
Output low-level voltage	V_{OL1}	DO, T3, T4, T5, T6, T7	$I=2\text{mA}$			0.5	V
	V_{OL2}	SYNC, RDS-ID	$I=8\text{mA}$			0.5	V
Input high-level current	I_{IH1}	CL, DI, CE, SYR, T1, T2	$V_I=V_{DDD}$			5.0	μA
	I_{IH2}	XIN	$V_I=V_{DDD}$	0.9		4.0	μA
Input low-level current	I_{IL1}	CL, DI, CE, SYR, T1, T2	$V_I=0\text{V}$			5.0	μA
	I_{IL2}	XIN	$V_I=0\text{V}$	0.9		4.0	μA
Output off leakage current	I_{OFF}	DO, SYNC, RDS-ID, T3, T4, T5, T6, T7	$V_O=6.5\text{V}$			5.0	μA
Current drain	I_{DD}	V_{DDD}, V_{DDA}	$V_{DDD}=V_{DDA}=3.3\text{V}$		6		mA

LC72720YVS

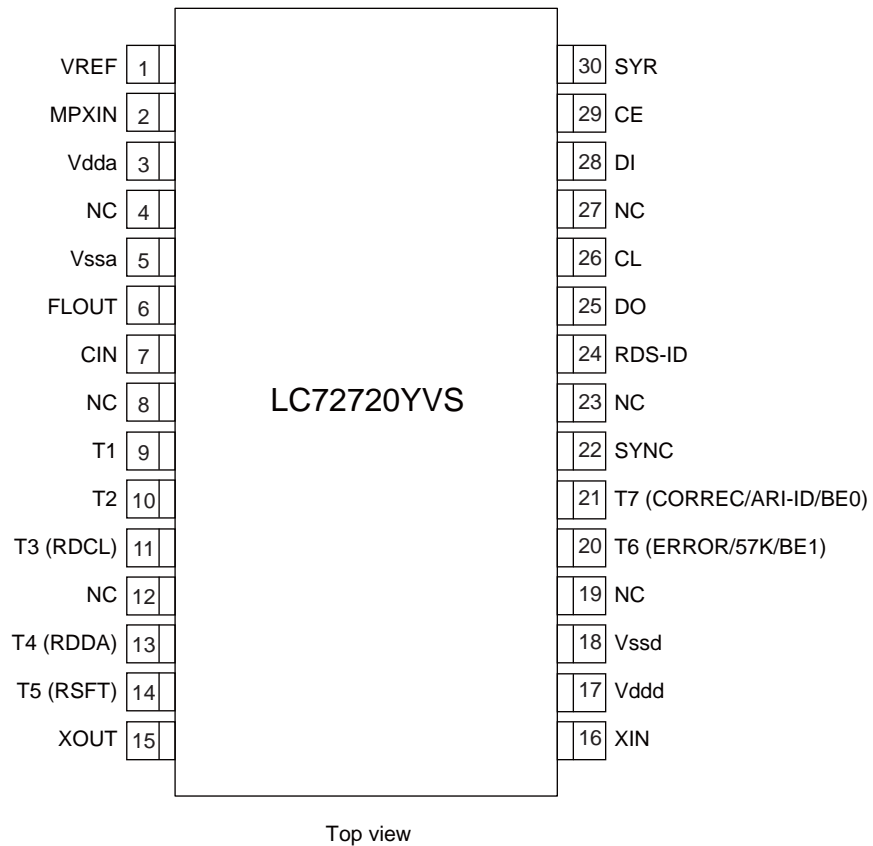
Package Dimensions

unit : mm (typ)

3191C

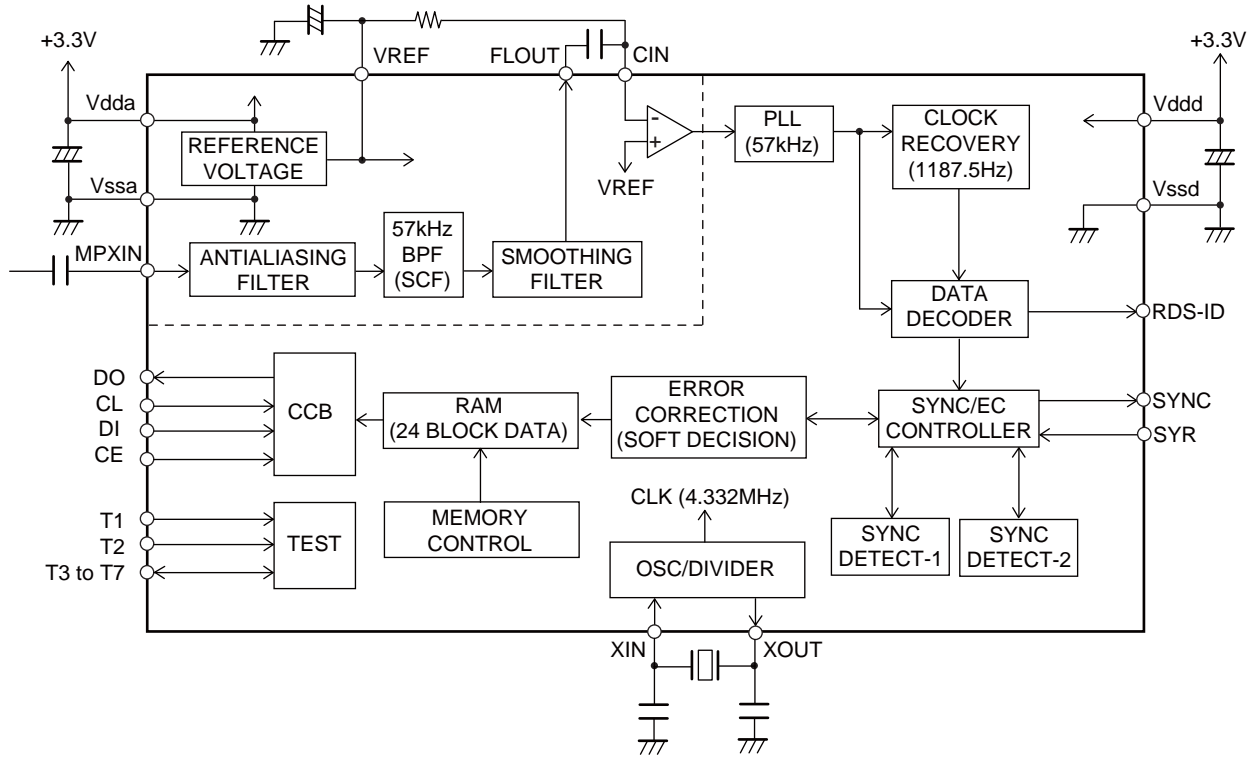


Pin Assignment



LC72720YVS

Block Diagram



LC72720YVS

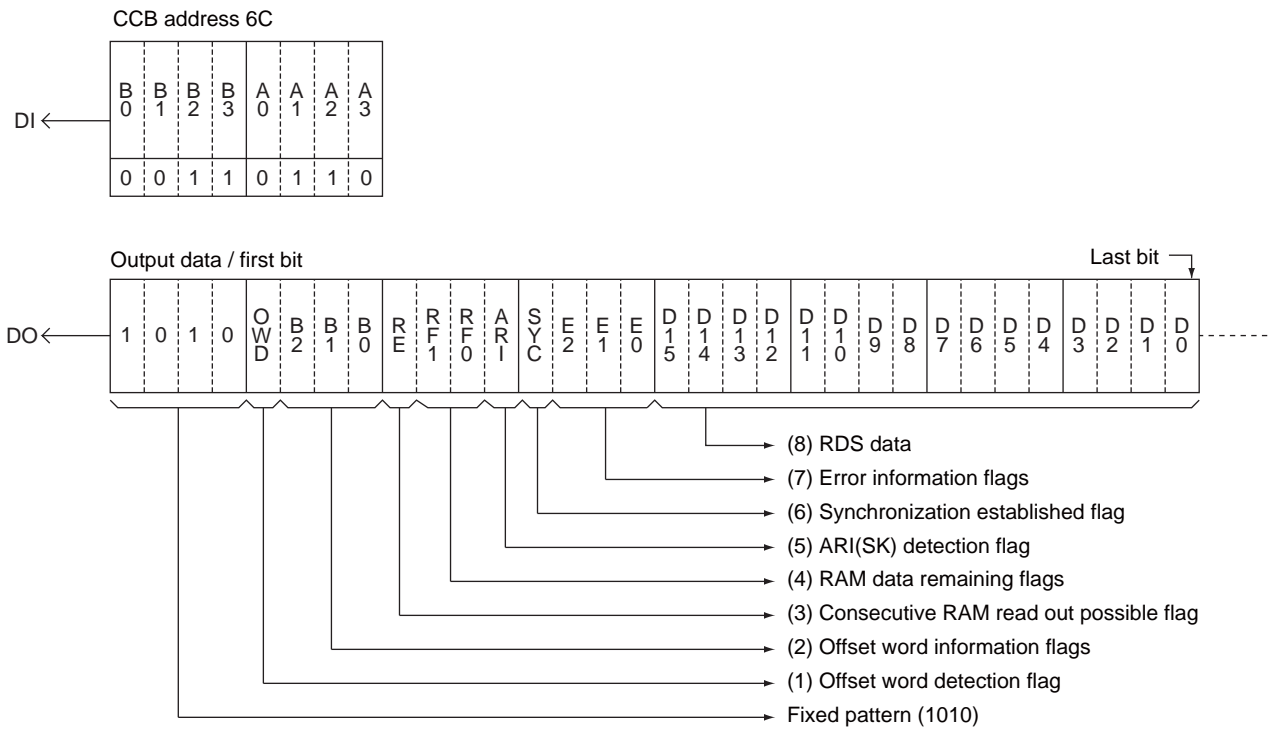
Pin Functions

Pin No.	Pin name	Function	I/O	Pin circuit
1	VREF	Reference voltage output (Vdda/2)	Output	
2	MPXIN	Baseband (multiplexed) signal input	Input	
6	FLOUT	Subcarrier output (filter output)	Output	
7	CIN	Subcarrier input (comparator input)	Input	
3	Vdda	Analog system power supply (+3.3V)	-	-
5	Vssa	Analog system ground	-	-
15	XOUT	Crystal oscillator output (4.332/8.664MHz)	Output	
16	XIN	Crystal oscillator input (external reference signal input)	Input	
9	T1	Test input (This pin must always be connected to ground.)	Input	
10	T2	Test input (standby control) 0:Normal operation, 1:Standby state (crystal oscillator stopped)		
11	T3(RDCL)	Test I/O (RDS clock output)	I/O*	
13	T4(RDDA)	Test I/O (RDS data output)		
14	T5(RSFT)	Test I/O (soft-decision control data output)		
20	T6 (ERROR/57K/BE1)	Test I/O (error status, regenerated carrier, error block count)		
21	T7 (CORREC/ARI-ID/BE0)	Test I/O (error correction status, SK detection, error block count)		
22	SYNC	Block synchronization detection output	Output	
24	RDS-ID	RDS detection output		
25	DO	Data output	Input	
26	CL	Clock input		
28	DI	Data input		
29	CE	Chip enable		
30	SYR	Synchronization and RAM address reset (active high)		
17	Vddd	Digital system power supply (+3.3V)	-	-
18	Vssd	Digital system ground	-	-

Note : * Normally function as an output pin. Used as an I/O pin in test mode, which is not available to user applications. Pin 4, 8, 12, 19, 23, 27 are NC (NO CONNECT) Pins.

CCB output data format

1. Each block of output data consists of 32 bits (4 bytes), of which 2 bytes are RDS data and 2 bytes are flag data.
2. Any number of 32-bits output data blocks can be output consecutively.
3. When there is no data that can be read out in the internal memory, the system outputs blocks of all-zero data consecutively.
4. If data readout is interrupted, the next read operation starts with the 32-bit data block whose readout was interrupted.
However, if only the last bit is remaining to be read, it will not be possible to re-read that whole block.
5. The check bits (10 bits) are not output.
6. The data valid (OWD) must not be referred to.
7. When the first leading bits are not "1010", the read in data is in invalid, and read operation is cancelled.



(1) Offset word detection flag (1bit) : OWD

OWD	Offset word detection
1	Detected
0	Not detected (protection function operating)

(2) Offset word information flag (3bit) : B0 to B2

B ₂	B ₁	B ₀	Offset word
0	0	0	A
0	0	1	B
0	1	0	C
0	1	1	C'
1	0	0	D
1	0	1	E
1	1	0	Unused
1	1	1	Unused

LC72720YVS

(3) Consecutive RAM read out possible flag (1bit) : RE

RE	RAM data information
1	The next data to be read out is in RAM
0	This data item is the last item in RAM, and the next data is not present.

(4) RAM data remaining flag (2bits) : RF0,RF1

RF1	RF0	Remaining data in RAM (number of blocks)
0	0	1 to 7
0	1	8 to 15
1	0	16 to 23
1	1	24

Caution : This value is only meaningful when RE is 1. When RE is 0, there is no data in RAM, even if RF is 00.
If a synchronization reset was applied using SYR, then the backward protection block data that was written to memory is also counted in this value.

(5) ARI(SK) detection flag (1bit) : ARI

ARI	SK signal
1	Detected
0	Not detected

(6) Synchronization established flag (1bit) : SYC

SYC	Synchronization detection
1	Synchronized
0	Not synchronized

Caution : This flag indicates the synchronization state of the circuit at the point when the data block being output was received.
On the other hand, the SYNC pin (pin18) output indicates the current synchronization state of the circuit.

(7) Error information flags (3bits) : E0 to E2

E 2	E 1	E 0	Number of bits corrected
0	0	0	0 (no errors)
0	0	1	1
0	1	0	2
0	1	1	3
1	0	0	4
1	0	1	5
1	1	0	Correction not possible
1	1	1	Unused

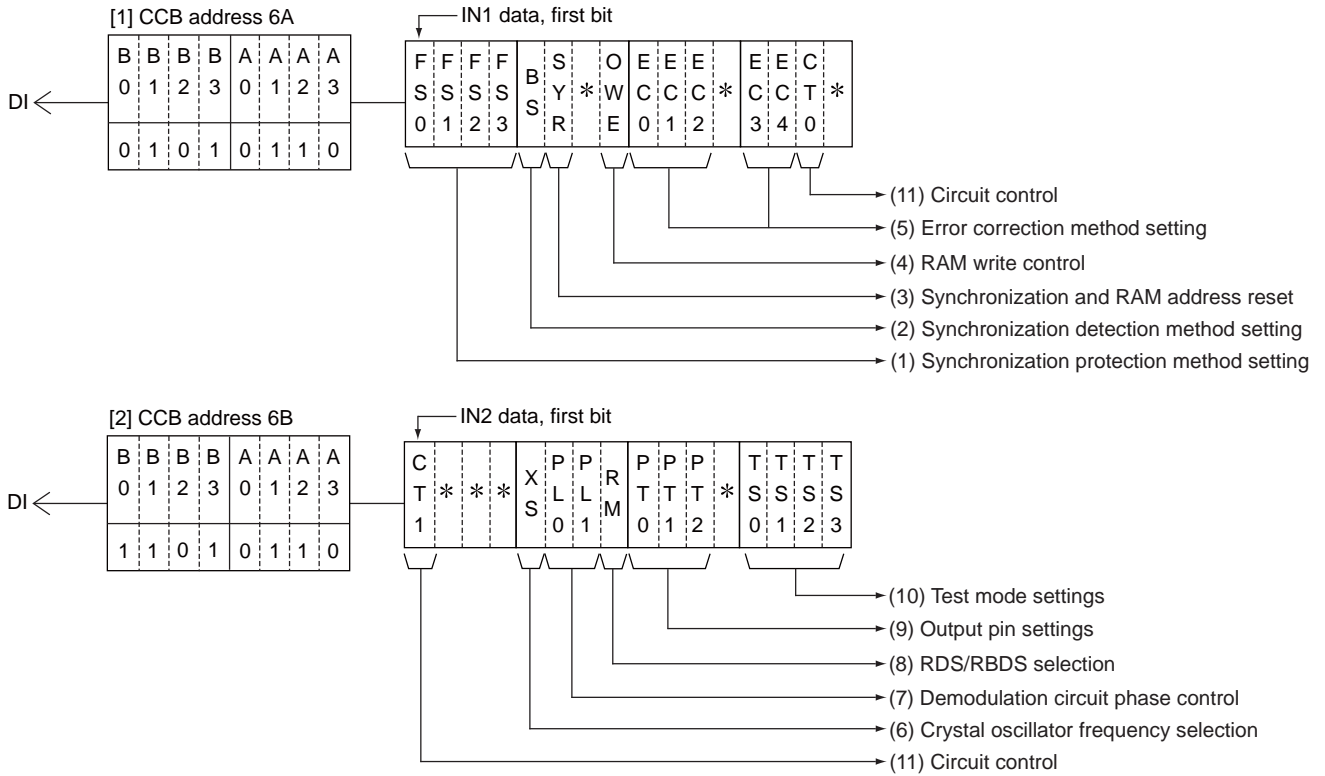
Caution : If the number of errors exceeds the value of the EC0 to EC2 setting (see the section on the CCB input format), the error information flags will be set to the "Correction not possible" value.

(8) RDS data (16bits) : D0 to D15

This data is output with the MSB first and the LSB last.

Caution : When error correction was not possible, the input data is output without change.

CCB Input data format



Caution : The bits labeled with an asterisk must be set to 0.

(1) Synchronization protection (forward protection) method setting (4bits) : FS0 to FS3

FS3 = 0 : If offset words in the correct order could not be detected continuously during the number of blocks specified by FS0 to FS2, take that to be a lost synchronization state.

FS3 = 1 : If blocks with uncorrectable errors were received consecutively during the number of blocks specified by FS0 to FS2, take that to be a lost synchronization state.

F S 0	F S 1	F S 2	Condition for detecting lost synchronization
0	0	0	If 3 consecutive blocks matching the FS3 condition are received.
1	0	0	If 4 consecutive blocks matching the FS3 condition are received.
0	1	0	If 5 consecutive blocks matching the FS3 condition are received.
1	1	0	If 6 consecutive blocks matching the FS3 condition are received.
0	0	1	If 8 consecutive blocks matching the FS3 condition are received.
1	0	1	If 10 consecutive blocks matching the FS3 condition are received.
0	1	1	If 12 consecutive blocks matching the FS3 condition are received.
1	1	1	If 16 consecutive blocks matching the FS3 condition are received.

Initial value : FS0 = 0, FS1 = 1, FS2 = 0, FS3 = 0

LC72720YVS

(2) Synchronization detection method setting (1bit) : BS

BS	Synchronization detection conditions
0	If during 3 blocks, 2 blocks of offset words were detected in the correct order.
1	If the offset words were detected in the correct order in 2 consecutive blocks.

Initial value : BS = 0

(3) Synchronization and RAM address reset (1bit) : SYR

SYR	Synchronization detection circuit	RAM
0	Normal operation (reset cleared)	Normal write (See the description of the OWE bit)
1	Forced to the unsynchronized state (synchronization reset)	After the reset is cleared, start writing from the data prior to the establishment of synchronization, i.e. the data in backward protection.

Initial value : SYR = 0

- Caution :
- To apply a synchronization reset, set SYR to 1 temporarily using CCB, and then set it back to 0 again using CCB. The circuit will start synchronization capture operation at the point SYR is set to 0.
 - The SYR pin (pin30) also provides an identical reset control operation. Applications can use either method. However, the control method that is not used must be set to 0 at all times. Any pulse with a width of over 250 ns will suffice.
 - A reset must be applied immediately after the reception channel is changed. If a reset is not applied, reception data from the previous channel may remain in on-chip memory.
 - Data read out after a synchronization reset is read out starting with the backward protection block data preceding the establishment of synchronization.

(4) RAM write control (1bit) : OWE

OWE	RAM write conditions
0	Only data for which synchronization had been established is written.
1	Data for which synchronization not has been established (unsynchronized data) is also written. (However, this applies when SYR = 0.)

Initial value : OWE = 0

(5) Error correction method setting (5bits) : EC0 to EC4

E C 0	E C 1	E C 2	Number of bits corrected
0	0	0	0 (error detection only)
1	0	0	1 or fewer bits
0	1	0	2 or fewer bits
1	1	0	3 or fewer bits
0	0	1	4 or fewer bits
1	0	1	5 or fewer bits
0	1	1	Illegal value
1	1	1	Illegal value

E C 3	E C 4	Soft-decision setting
0	0	MODE0 Hard decision
1	0	MODE1 Soft decision A
0	1	MODE2 Soft decision B
1	1	Illegal value

Initial values : EC0 = 0, EC1 = 1, EC2 = 0, EC3 = 0, EC4 = 1

- Caution :
- If soft-decision A or soft-decision B is specified, soft-decision control will be performed even if the number of bits corrected is set to 0 (error detection only). With these settings, data will be output for blocks with no errors.
 - As opposed to soft-decision B, the soft-decision A setting suppresses soft decision error correction.

LC72720YVS

(6) Crystal oscillator frequency selection (1bit) : XS

XS = 0 : 4.332MHz (Initial value : XS = 0)
 XS = 1 : 8.664MHz

(7) Demodulation circuit phase control (2bits) : PL0, PL1

PL0	PL1	Demodulation circuit phase control
0	0/1	< Normal operation > when ARI presence or absence is unclear.
1	0	If the circuit determines that the ARI signal is absent : 90° phase
	1	If the circuit determines that the ARI signal is present : 0° phase

Initial values : PL0 = 0, PL1 = 1

Caution : 1. When PL0 is 0 (normal operation), the IC detects the presence or absence of the ARI signal and reproduces the RDS data by automatically controlling the demodulation phase with respect to the reproduced carrier. However, the initial phase following a synchronization reset is set by PL1.

2. If PL0 is set to 1, the demodulation circuit phase is locked according to the PL1 setting at either 90° (PL1 = 0) or 0° (PL1 = 1), allowing RDS data to be reproduced. When ARI is not present, PL1 should be set to 0, since the RDS data is reproduced by detecting at a phase of 90° with respect to the reproduced carrier. When ARI is present, PL1 should be set to 1, since detection is at 0°. In cases where the ARI presence is known in advance, more stable reproduction can be achieved by fixing the demodulation phase in this manner.

(8) RDS/RBDS(MMBS) selection (1bit) : RM

RM	RBDS	Decoding method
0	None	Only RDS data is decoded correctly (Offset word E is not detected.)
1	Provided	RDS and MMBS data is decoded correctly (Offset word E is also detected.)

Initial value : RM=0

(9) Output pin settings (3bits) : PT0 to PT2

These bits control the T3, T4, T5, T6, T7, SYNC, and RDS-ID pins

MODE	P	P	P	T3	T4	T5	T6			T7		
	T	T	T				ERROR	57K	BE1	CORREC	ARI-ID	BE0
	0	1	2	RDCL	RDDA	RSFT						
0	0	0	0	—	—	—	—	—	—	—	—	—
1	1	0	0	○	○	○	—	—	—	—	—	—
2	0	1	0	○	○	○	—	○	—	—	○	—
3	1	1	0	○	○	○	○	—	—	○	—	—
4	0	0	1	—	—	—	—	—	○	—	—	○
5	1	0	1	●	○	○	—	—	—	—	—	—
6	0	1	1	●	○	○	—	●	—	—	●	—
7	1	1	1	●	○	○	●	—	—	●	—	—

— : open, ○, ● : Output enabled (● = reverse polarity)

Initial value : PT0 = 1, PT1 = 1, PT2 = 0 (Mode 3)

Caution : 1. When PT2 is set to 1, the polarity of the T3(RDCL), T6(ERROR/57K), T7(CORREC/ARI-ID), SYNC, and RDS-ID pins changes to active high.

2. The output pins (T3 to T7, SYNC, and RDS-ID) are all open-drain pins, and require external pull-up resistors to output data.

LC72720YVS

Item	Pin T3 (RDCL)
PT2 = 0	Data(RDDA and RSFT) changes on this pin's rising edge
PT2 = 1	Data(RDDA and RSFT) changes on this pin's falling edge

Mode2 (PT2 = 0)	Pin T7 (ARI-ID)
No SK	High (1)
SK present	Low (0)

Mode3 (PT2 = 0)	Pin T6 (ERROR)	Pin T7 (CORREC)
Correction not possible	Low (0)	Low (0)
Errors corrected	High (1)	Low (0)
No errors	High (1)	High (1)

Mode = 4	Pin T6 (BE1)	Pin T7 (BE0)
Number of error blocks (B)		
B=0	Low (0)	Low (0)
$1 \leq B \leq 20$	Low (0)	High (1)
$20 < B \leq 40$	High (1)	Low (0)
$40 < B \leq 48$	High (1)	High (1)

These pins indicate the number of blocks in a set of 48 blocks that had errors before correction. The output polarity of these pins is fixed at the values listed in the table.

Mode (PT2 = 0)	The SYNC pin
0 to 2	When synchronized : Low (0), When unsynchronized: High (1)
3	When synchronized : Goes high for a fixed period (421 μ s) at the start of a block and then goes low. When unsynchronized : High (1)

Caution : The output indicates the synchronization state for the previous block.

When PT2 = 0	The RDS-ID pin
No RDS	High (1)
RDS present	Low (0)

- (10) Test mode settings (4bits) : TS0 to TS3
Initial values : TS0 = 0, TS1 = 0, TS2 = 0, TS3 = 0
(Applications must set these bits to the above values.)

Notes : The T1 and T2 pins (pins 9 and 10) are related to test mode as follows.

Pin T1	Pin T2	IC operation	Notes
0	0	Normal operating mode	These states are user settable
0	1	Standby mode (crystal oscillator stopped)	
1	0/1	IC test mode	Users cannot use this state

The T1 pin must be tied to V_{SS} (0V).

- (11) Circuit control (2 bits) : CT0 and CT1

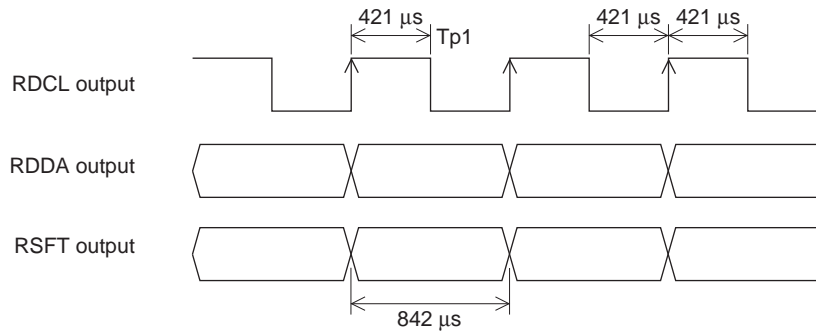
	Item	Control
CT0	RSFT control	When set to 1, soft-decision control data (RSFT) is easier to generate.
CT1	RDS-ID detection condition	When set to 1, the RDS-ID detection conditions are made more restrictive.

Initial value : CT0 = 0, CT1 = 0

LC72720YVS

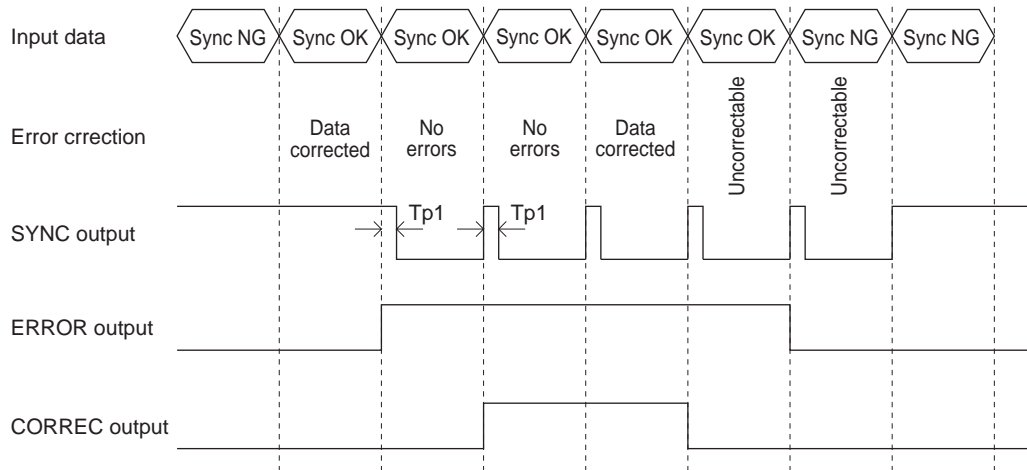
RDCL / RDDA / RSFT and ERROR / CORREC / SYNC output timing

(1) Timing 1



Note : When $PT2 = 0$, RDDA and RSFT must be acquired on the falling edge of RDCL.

(2) Timing 2 (mode 3, $PT2 = 0$)

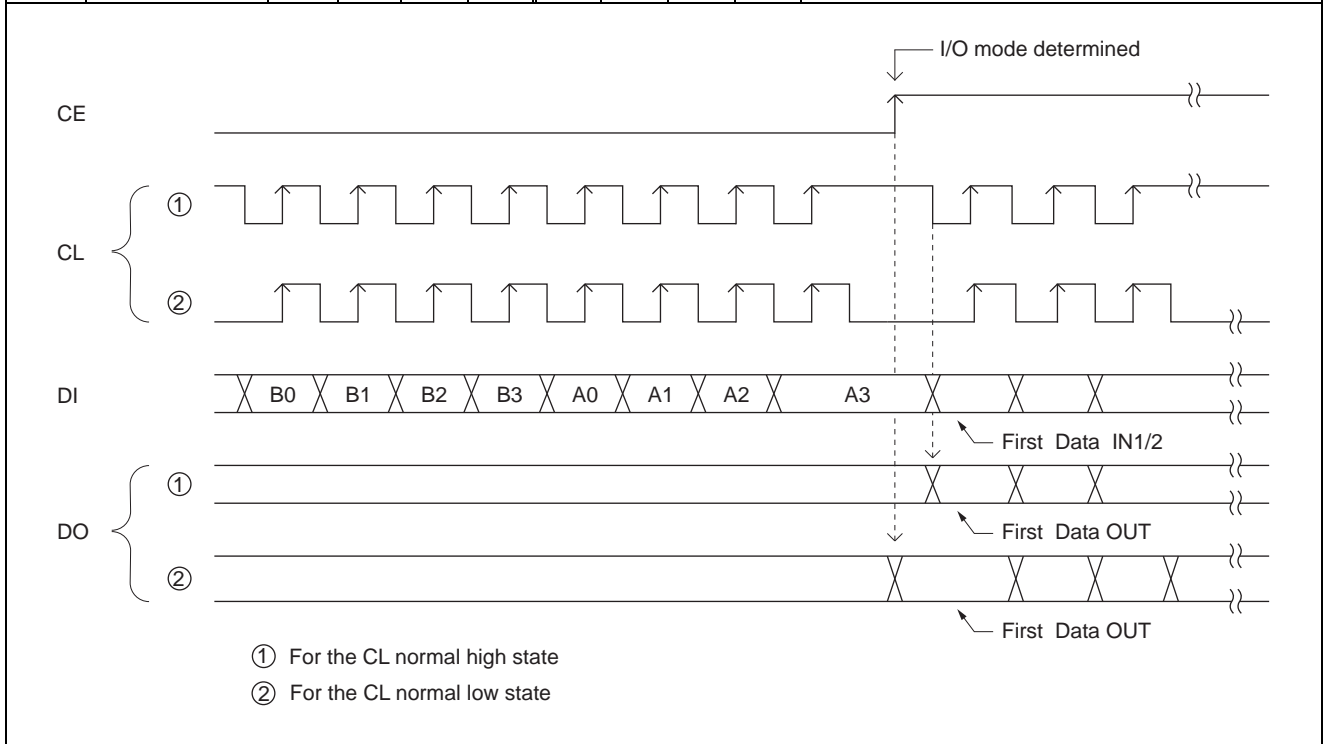


LC72720YVS

Serial Data Input and Output Methods

Data is input and output using the CCB (Computer Control Bus), which is the SANYO audio IC serial bus format. This IC adopts an 8-bit address CCB format.

	I/O mode	Address								Comment
		(LSB)				(MSB)				
		B0	B1	B2	B3	A0	A1	A2	A3	
[1]	IN1 (6A)	0	1	0	1	0	1	1	0	<ul style="list-style-type: none"> Control data input mode, also referred to as "serial data input" mode. 16bit data input mode
[2]	IN2 (6B)	1	1	0	1	0	1	1	0	
[3]	OUT (6C)	0	0	1	1	0	1	1	0	<ul style="list-style-type: none"> Data output mode The data for multiple blocks can be output sequentially in this mode.

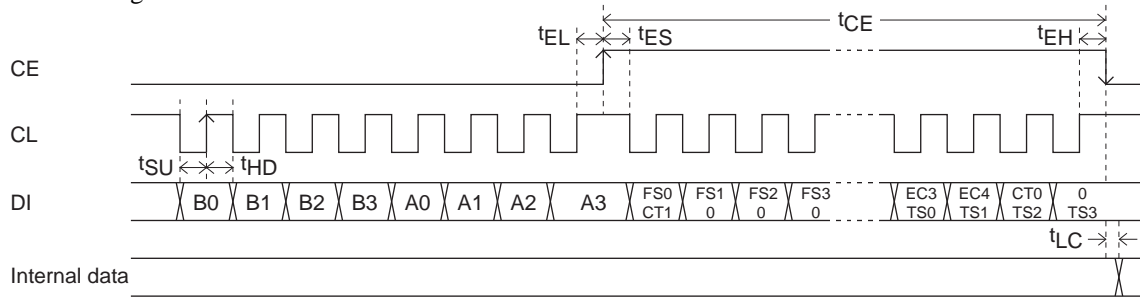


LC72720YVS

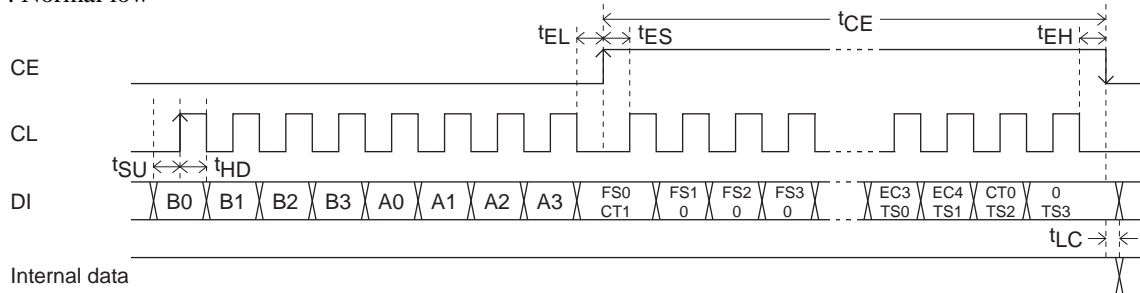
(1) Serial data input (IN1 / IN2)

$t_{SU}, t_{HD}, t_{EL}, t_{ES}, t_{EH} \geq 0.75\mu s$ $t_{LC} < 1.15\mu s$ $t_{CE} < 20 ms$

① CL : Normal high



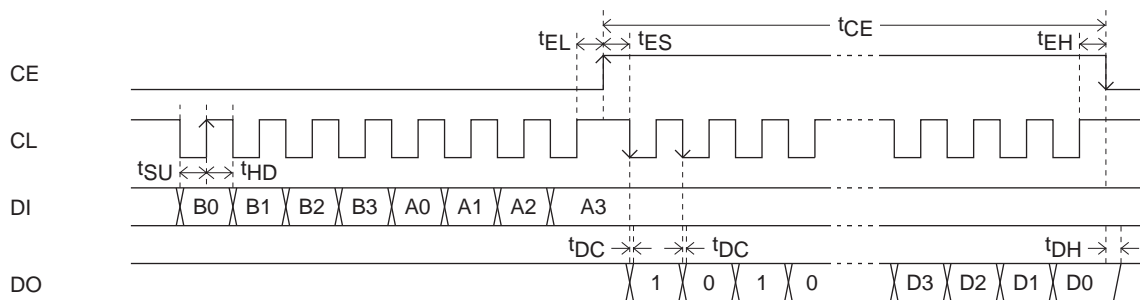
② CL : Normal low



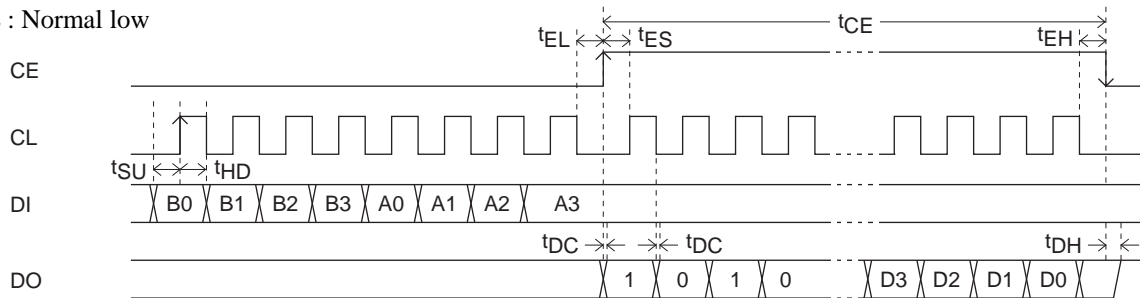
(2) Serial data output (OUT)

$t_{SU}, t_{HD}, t_{EL}, t_{ES}, t_{EH} \geq 0.75\mu s$ $t_{DC}, t_{DH} < 0.46\mu s$ $t_{CE} < 20 ms$

① CL : Normal high



② CL : Normal low



Cautions : 1. Since the DO pin is an n-channel open-drain output, the transition times (t_{DC} , t_{DH}) will differ with the value of the pull-up resistor used.

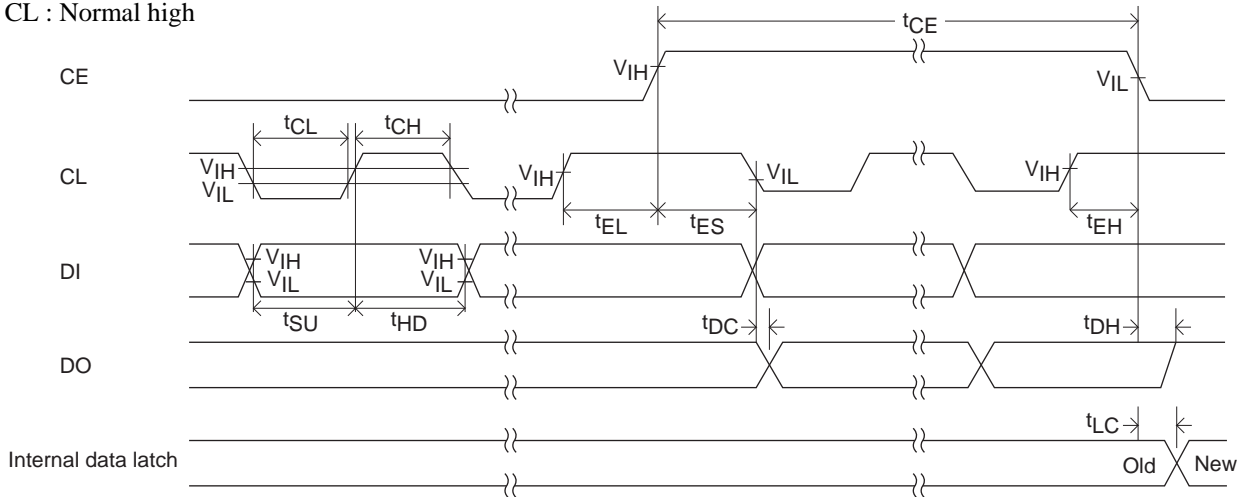
2. The CE, CL, DI, and DO pins can be connected to the corresponding pins on other ICs that use the CCB interface. (However, we recommend connecting the DO and CE pins separately if the number of available microcontroller ports allows it.)

3. Serial data I/O becomes possible after the crystal oscillator starts oscillation.

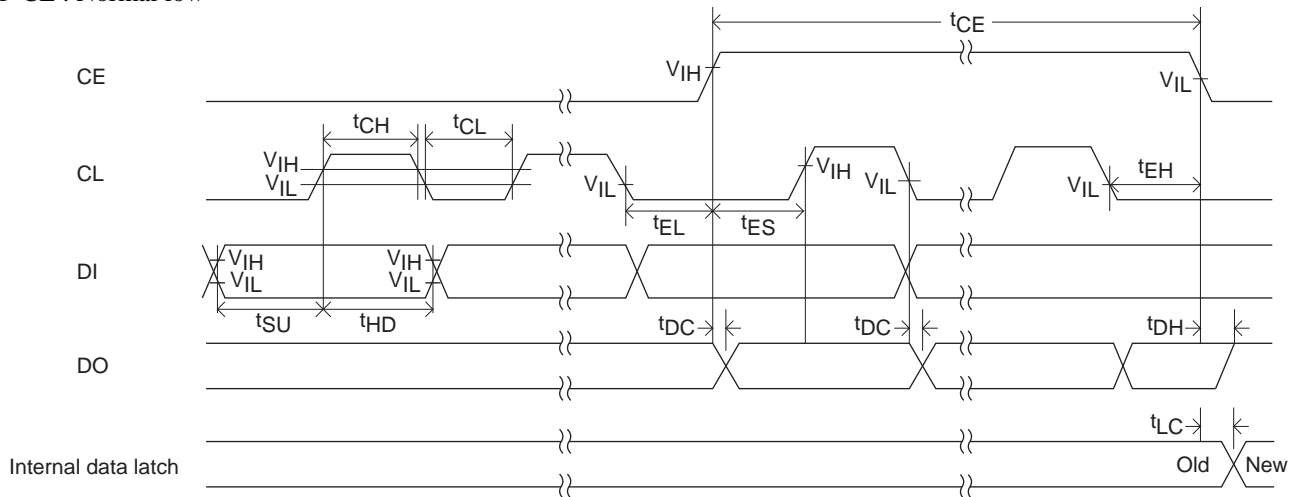
LC72720YVS

(3) Serial data timing

① CL : Normal high



② CL : Normal low

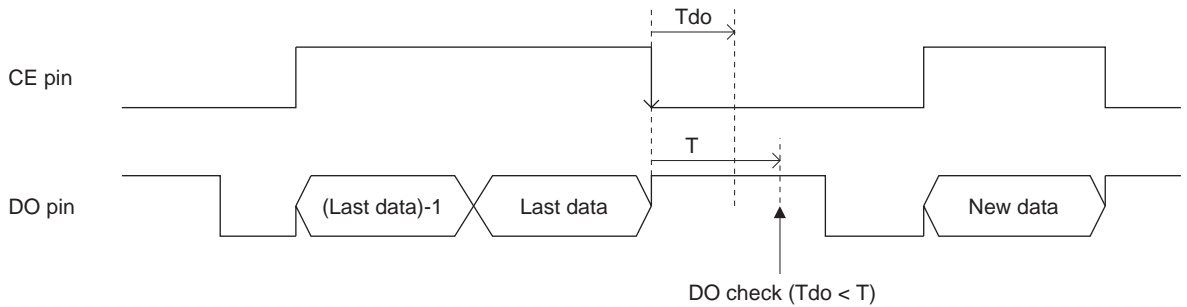


Parameter	Symbol	Conditions	min	typ	max	Unit
Data setup time	t_{SU}	DI, CL	0.75			μs
Data hold time	t_{HD}	DI, CL	0.75			μs
Clock low level time	t_{CL}	CL	0.75			μs
Clock high level time	t_{CH}	CL	0.75			μs
CE wait time	t_{EL}	CE, CL	0.75			μs
CE setup time	t_{ES}	CE, CL	0.75			μs
CE hold time	t_{EH}	CE, CL	0.75			μs
CE high level time	t_{CE}	CE			20	ms
Data latch transition time	t_{LC}				1.15	μs
Data output time	t_{DC}	DO, CL			0.46	μs
	t_{DH}	DO, CE			0.46	μs

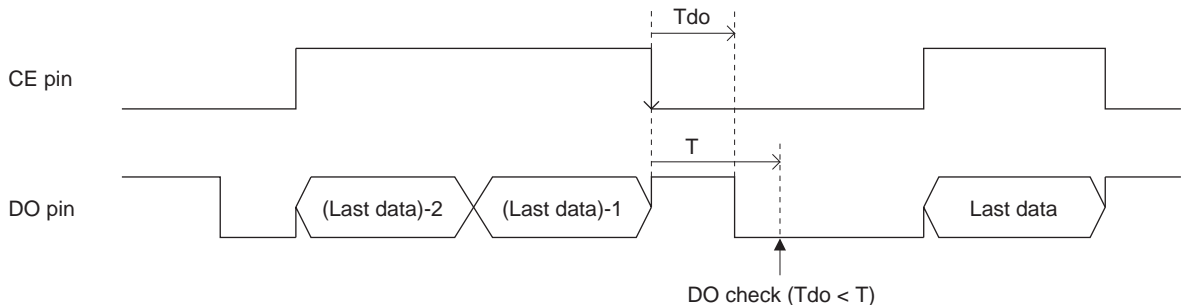
DO pin operation

This IC incorporates a RAM data buffer that can hold up to 24 blocks of data. At the point when one block of data is written to this RAM, the IC issues a read request by switching the DO pin from high to low. The DO pin always goes high for a fixed period ($T_{do} = 265 \mu s$) after a readout and CE goes low. When all the data in the data buffer has been read out, the DO pin is held in the high state until a new block of data has been written to the RAM. If there is data that has not yet been read remaining in the data buffer, the DO pin goes low after the T_{do} time has elapsed. After a synchronization reset, the DO pin is held high until synchronization is established. It goes low at the point the IC synchronizes.

- ① When the DO pin is high following the $265 \mu s$ period (T_{do}) after data is read out. Here, the buffer is in the empty state, i.e. the state where new data has not been written. After this, when the DO pin goes low, applications are guaranteed to be able to read out that data without it being overwritten by new data if they start a readout operation within 480 ms of DO going low.



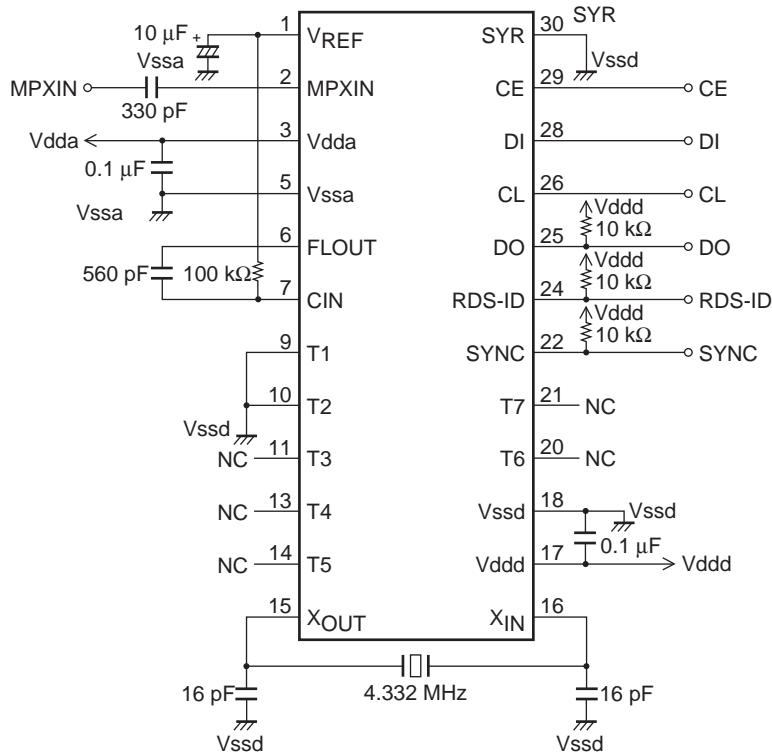
- ② When DO goes low $265 \mu s$ after data is read out. Here, there is data that has not been read out remaining in the data buffer. In this case, applications are guaranteed to be able to read out that data without it being overwritten by new data if they start a readout operation within 20 ms of DO going low. (Note that this is the worst case condition.)



- Notes :
1. Although an application can determine whether or not there is data remaining in the buffer by checking the DO level with the above timing, checking the RE and RF flags in the serial data is a preferable method.
 2. Applications are not limited to reading out one block of data at a time, but rather can read out multiple blocks of data continuously as described above. When using this method, if an application references the RE and RF flags in the data while reading out data, it can determine the amount of data remaining. However, the length of the period for data readout (the period the CE pin remains high) must be kept under 20 ms.
 3. If the DO pin is shared with other ICs that use the CCB interface, the application must identify which IC issued the readout request. One method is to read out data from the LC72720YVS and either check whether meaningful data has been read (if the LC72720YVS is not requesting a read, data consisting of all zeros will be read out) or check whether the DO level goes low within the $256 \mu s$ following the completion of the read (if the DO pin goes low, then the request was from another IC).

LC72720YVS

Sample Application circuit



- Caution :
1. Determine the value of the DO pin pull-up resistor based on the required serial data transfer speed.
 2. A 100-kΩ bias resistor must be connected between the CIN pin and the VREF pin. Note that this resistor is planned to be included internally to the IC in later versions of this product.
 3. If the SYR pin is unused, it must be connected to ground.

- SANYO Semiconductor Co.,Ltd. assumes no responsibility for equipment failures that result from using products at values that exceed, even momentarily, rated values (such as maximum ratings, operating condition ranges, or other parameters) listed in products specifications of any and all SANYO Semiconductor Co.,Ltd. products described or contained herein.
- Regarding monolithic semiconductors, if you should intend to use this IC continuously under high temperature, high current, high voltage, or drastic temperature change, even if it is used within the range of absolute maximum ratings or operating conditions, there is a possibility of decrease reliability. Please contact us for a confirmation.
- SANYO Semiconductor Co.,Ltd. strives to supply high-quality high-reliability products, however, any and all semiconductor products fail or malfunction with some probability. It is possible that these probabilistic failures or malfunction could give rise to accidents or events that could endanger human lives, trouble that could give rise to smoke or fire, or accidents that could cause damage to other property. When designing equipment, adopt safety measures so that these kinds of accidents or events cannot occur. Such measures include but are not limited to protective circuits and error prevention circuits for safe design, redundant design, and structural design.
- In the event that any or all SANYO Semiconductor Co.,Ltd. products described or contained herein are controlled under any of applicable local export control laws and regulations, such products may require the export license from the authorities concerned in accordance with the above law.
- No part of this publication may be reproduced or transmitted in any form or by any means, electronic or mechanical, including photocopying and recording, or any information storage or retrieval system, or otherwise, without the prior written consent of SANYO Semiconductor Co.,Ltd.
- Any and all information described or contained herein are subject to change without notice due to product/technology improvement, etc. When designing equipment, refer to the "Delivery Specification" for the SANYO Semiconductor Co.,Ltd. product that you intend to use.
- Upon using the technical information or products described herein, neither warranty nor license shall be granted with regard to intellectual property rights or any other rights of SANYO Semiconductor Co.,Ltd. or any third party. SANYO Semiconductor Co.,Ltd. shall not be liable for any claim or suits with regard to a third party's intellectual property rights which has resulted from the use of the technical information and products mentioned above.

This catalog provides information as of November, 2012. Specifications and information herein are subject to change without notice.