LC786830 Software Functional Specifications

AND90065/D

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APPLICATION NOTE

Overview

This application note describes the functional specifications of the software embedded in LC786830.

LC786830 integrates an Arm® Cortex®−M0+ processor, an Arm Cortex−M3 processor, USB controllers, compressed audio decoder and Bluetooth® audio.

External flash memories can be connected to LC786830, to store program code for the Arm Cortex−M0+ and Arm Cortex−M3 processors and the audio DSP. This provides the flexibility required to develop high performance and multi−functional audio player systems.

The Arm Cortex−M3 processor is for Audio control program operation, and it also controls USB Media, SD Media, Bluetooth Media, and various audio function for the Arm Cortex−M0+ processor is for program operation and provides system control, key control, display control and radio tuner control, as well as controlling the Arm Cortex−M3 processor for audio playback.

Key Features

- Dual CPU System with Arm Cortex−M0+ and Cortex−M3 Processors
- USB 2.0 OTG (High Speed/Full Speed) Controller
- USB 2.0 Host (Full Speed) Controller
- SD Memory Card Host Function
- Processing Decode MP3, WMA, AAC and FLAC
- Analog Selector Input for Audio Input Functions
- Digital Input for Audio Input Functions with Sampling Rate Converter

Key Features (Continued)

- Digital Audio Signal Processing Functions such as High−frequency Range Extendable Filter, 22 Bands Equalizer, Audio Mixing, Volume Control, and etc.
- Audio Output Functions such as Electrical Volume Output 5ch (for LF, LR, RF, RR and SW)
- Bluetooth 5.1 with Audio Playback and Hands−free Function

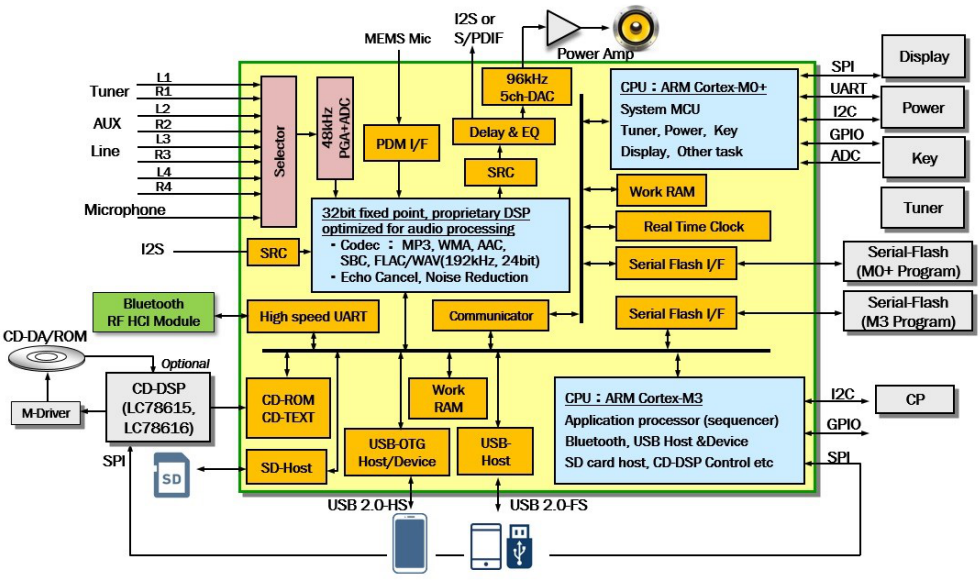

Figure 1. Block Diagram of LC786830

Functional Specifications

Table 1. FUNCTIONS FOR SYSTEM AND PLAYBACK

Item	Function	Description	
System	iPod Interface	Connected by USB Based on iAP2 (iPod Accessory Protocol)	
		Authentication with Co−pro	Ver. 3.0
	Bluetooth Interface	Connected with BT−RF module	
		By UART	General data communication, Audio (A2DP) data communication
		By I2S	Hands−free Voice communication
	Audio Output	Electronic Volume	Supported
		Digital 3−lines interface (I2S)	Supported
		DOUT (S/PDIF)	Supported
	Firmware Update	Self−update of application program area with USB memory drive	
Playback	Playback Media	CD−DA (include Mixed−CD)	Supported (Please refer to Table 2)
		CD−ROM (include Mixed−CD)	Supported (Please refer to Table 2)
		USB	Supported (Please refer to Table 3)
		iPod (iAP2 over USB)	Supported (Please refer to Table 8)
		SD card	Supported (Please refer to Table 3)
		Bluetooth Audio	Supported (Please refer to Table 9)
	Playback File	CD−DA track	Supported
		CD−ROM track with mute	By detecting digital bit
		MP3	File extension as “MP2”, “MP3”
		WMA	File extension as “WMA”
		AAC (M4A)	File extension as “M4A”
		FLAC (only USB or SD card)	File extension as “FLAC”
		WAV (only USB or SD card)	File extension as “WAV”

Table 2. FUNCTIONS FOR CD−DA, CD−ROM

Item	Function	Description	
CD−DA & CD−ROM	CD Media Control	By control of external CD−DSP, “LC78616”.	
		CD−servo playback speed	2x speed
		CD−DA music playback speed	1x speed with shock−proof control
		Shock−proof memory	16 Mbits SDRAM
		By using external 16 Mbits SDRAM, it takes 10.2 s shock−proof time.	
	CD Media Type	CD−DA	Supported
		CD−ROM	Supported
		CD−R	Supported
		CD−RW	Supported
	CD Recording Format	Disc at once	Supported
		Track at once	Supported
		Session at once	Supported
		Multi−session	Max 50 sessions
		Packet Write	Not supported ISO9660 Level 3 Not Supported UDF
	CD−servo Auto Adjustment	CD−servo auto adjustment (configurable by parameter setting) Adjustment for offset, gain, etc.	
	TOC Reading	CD TOC information read (configurable by parameter setting)	
		Multi session support is configurable by parameter setting	
	CD−TEXT	CD−TEXT information read (configurable by parameter setting)	
		Language Block	Max 8 blocks
	CD−ROM Mode	CD−ROM Mode 1	Supported
		CD−ROM Mode 2	Supported Form 1
		CD−ROM Mode 2	Supported Form 2
	CD−ROM File System	ISO9660 Level 1	Supported
		ISO9660 Level 2	Supported
		Romeo	Supported
		Joliet	Supported
		Apple ISO	Same as ISO9660 Level 2
		ISO9660−1999	Supported “SVD”
	CD−ROM File Contents Analysis	Folder analysis count	Max 256 (settable)
		File analysis count	Max 700 (settable)
		Tree of analysis folder	Max 8 tree levels (root included)
		Analysis sequence	Selectable Tree/Path table
		Character count of folder/file name	32 to 128 bytes It depends on maximum setting of folder and file
	Letters of File Name Extension	Upper case and lower case are mixed	Supported, such as MP3, mp3, Mp3 and mP3
	Maximum Duration Time of Playback per File	99 hours 59 minutes 59 seconds	If the max duration is exceeded, music playback is automatically stopped

Table 3. FUNCTIONS FOR USB OR SD CARD

Item	Function	Description	
USB	Version	Ver. 2.0 complaint (High Speed, Full Speed)	
	Supported Speed	High speed supported	Supported
	Supported Class	Mass storage class	Supported
		HID class driver	Supported
		HUB class driver	Supported
		Audio class driver	Supported
	Supported Sub Class	SCSI	Not supported SFF−8020i, MMC−2 (ATAPI)
	Communication Protocol	Bulk only	Supported
	Partition	Single only	In case of multi−partitions, Detect only first partition
	HUB, Maximum Port Count	Not supported	Playback is possible in case of only in HUB 1st block inside USB device
	Card Reader	Not supported	Playback is possible in the case of only card reader is connected with inserted memory media
SD Card *	Version	Physical Layer Specification Version 2.00	
	Support Size	SD (up to 2 GB), SDHC (up to 32 GB)	
	Voltage	2.7−3.6 V	
	Clock	6 MHz	
USB/SD file system	File System	FAT 12	Supported
		FAT 16	Supported
		FAT 32	Supported
		VFAT	Supported
	Sector Size	Maximum 4096	Supported
	Volume Size	Maximum 32 GB	FAT 32
	File Size	Maximum 4 GB	FAT 16, FAT 32 It has limitation of max duration time
	Contents Analysis	Folder analysis count	Max 256 (settable)
		File analysis count	Max 65535 (settable)
		File analysis count per folder	Max 999 (settable)
		Tree of analysis folder	Max 8 tree levels (root included)
		Character count of folder name	Max 64 or 128 (selectable)
		Character count of file name	Max 64 or 128 (selectable)
	Letters of File Name Extension	Upper case and lower case are mixed	Supported, such as, MP3, mp3, mP3
	Maximum Duration Time of Playback per File	99 hours 59 minutes 59 seconds	If the max duration is exceeded, music playback is automatically stopped

Table 4. FUNCTIONS FOR COMPRESSED AUDIO FILE FOR MP3, WMA

Item	Function	Description	
MP3	Version	Compliant to ISO/IEC 11172−3 and ISO/IEC 13818−3	
	Supported Sampling Frequency	MPEG1−Layer 2, Layer 3	32 kHz, 44.1 kHz, 48 kHz
		MPEG2−Layer 2, Layer 3	16 kHz, 22.05 kHz, 24 kHz
		MPEG2.5−Layer 3	8 kHz, 11.025 kHz, 12 kHz
		VBR (variable bit rate)	Supported
	Supported Bit Rate	MPEG1−Layer 2, Layer 3	32 kbps to 384 kbps
		MPEG2−Layer 2, Layer 3	8 kbps to 160 kbps
		MPEG2.5−Layer 3	8 kbps to 160 kbps
	Channel Mode	Stereo, Joint Stereo, Dual Channel, Mono	
	De−emphasis	50 or 15 [μs]	Supported
		CCITT j.17	Supported
	Header	MPEG header read	Supported
	TAG Information	Ver. 1.x	Supported
		Ver. 2.x	Supported Ver. 2.2, 2.3, 2.4 Not supported “Unsynchronisation”, “Compression”, “Encryption”
		Analysis mode	Selectable by function switch
		ID3 tag character count	Max 128 bytes
		ID3 tag flame	Supported “Title”, “Artist”, “Album”, “Genre”, “Comment”, “Year”
WMA	Version	WMA Ver. 9.2 Standard Level3	
	Supported Sampling Frequency	HIGH PROFILE	32 kHz, 44.1 kHz, 48 kHz
		MID PROFILE	16 kHz, 22.05 kHz, 24 kHz
		LOW PROFILE	8 kHz, 11.025 kHz, 12 kHz
	Supported Bit Rate	CBR	5 kbps to 320 kbps
		VBR	Max 384 kbps
	DRM	Detect DRM file and notifies error	
	TAG Information	WMA tag character count	Max 128 bytes
		ASF Header	Supported “Title”, “Author”, “Description”, “WM/Album title”, “WM/Genre”, “WM/Year”

Table 5. FUNCTIONS FOR COMPRESSED AUDIO FILE FOR AAC, FLAC AND WAV

Item	Function	Description	
AAC	Version	Compliant to ISO14496−3, 13818−7	
	Profile	MPEG4−AAC−Low Complexity Supported PNS, not supported SBR part of HE−AAC	
	Supported Sampling Frequency	Sampling frequency	8 kHz, 11.025 kHz, 12 kHz, 16 kHz, 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz, 48 kHz
	Supported Bit Rate	Monaural	8 kbps to 160 kbps, VBR
		Stereo	16 kbps to 320 kbps, VBR
	Channel Mode	Mono, Stereo, Dual Mono	
	Container Method	ISO base media file format	Compliant to ISO/IEC 14496−12
		MPEG4 file format	Compliant to ISO/IEC 14496−14
		Supported only “M4A” file made for iTunes (single AAC audio track) Not supported “multi AAC audio track” Not supported “copyrighted AAC audio (DRM)”	
	DRM	Detect DRM file and notifies error	
	AAC Tag Information	Complaint to iTunes metadata format specification version 6	Supported “Album name”, “Title”, “Artist name”, “Year”, “Comment”, “Genre”
		Character count	Max 128 bytes
	AAC Playback Position Information	Playback position count	300 points Each start position of playback is determined based on the position information of audio sample that recorded at the start of playback
FLAC	Version	Ver1.2.1 (Compliance to Subset Format)	
	Supported Sampling Frequency	8 kHz, 11.025 kHz, 12 kHz, 16 kHz, 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz, 48 kHz, 64 kHz, 88.2 kHz, 96 kHz, 128 kHz, 176.4 kHz, 192 kHz	
	Bits Per Sample	8, 16 or 24 bit per sample	
	Block Size	up to 4608	
	Channel Mode	Mono or Stereo	
	FLAC Tag Information	METADATA BLOCK VORBIS COMMENT	
		Character count	
WAV	Format	RIFF waveform Audio Format	
	Supported Sampling Frequency	8 kHz, 11.025 kHz, 12 kHz, 16 kHz, 22.05 kHz, 24 kHz, 32 kHz, 44.1 kHz, 48k Hz, 64 kHz, 88.2 kHz, 96 kHz, 128 kHz, 176.4 kHz, 192 kHz	
		16 or 24 bit	
	Channel	Mono or Stereo	
	Tag Information	Not Supported	

Table 6. FUNCTIONS FOR PLAYBACK

Item	Function	Description	
Playback	Playback Function for CD−DA	1st track playback	Supported
		Specified track playback	Supported
		Specified absolute time playback	For resuming playback instruction with MCU command
		Resume playback	Only during power on
	Playback Function for Compressed Audio File	1st file playback	No resume position information
		Specified folder and specified file Playback	Supported
		Specified file with specified play time playback	For resuming playback instruction with MCU command
		Resume playback	Only during power on
	Pause	Initial pause at 1st track or file	No resume position information
		Initial pause of specified folder and specified File	Supported
		Pause at specified file with specified play time	For resuming playback instruction with MCU command
		Pause at resume position	Supported
	Stop	Resume information store stop	Only during power−on
		Resume information clear stop	Supported
	Fast Forward (FF)	3 levels of speed setting are possible	
	Fast Rewind (REW)	3 levels of speed setting are possible	
	Skip Track or File	Skips to the beginning of the current track (or file) or before (or after) the track	
	Skip Folder	Skips to the beginning of the current folder or before (or after) the folder	
	REPEAT	Track or file repeat playback	Supported
		Folder repeat playback	Supported
		Disc or media repeat playback	Supported
	SHUFFLE	Folder shuffle playback	Max 999
		Media shuffle playback	Max 65535
		Resume shuffle playback	Supported
	SHUFFLE Control	Play shuffle	Supported pause
		Play shuffle skip	Supported pause
		Play shuffle folder skip	Supported pause
	Play−Order Setting Function	During play/FF (Fast forward) playback, pause is set at the end of track or file	
		During play/FF playback, pause is set at the end of folder	
		During play/FF playback, pause is set at the end of disc or media	
		During REW (Fast Rewind) playback, pause is set at the beginning of track or file	
		During REW playback, pause is set at the beginning of folder	
		During REW playback, pause is set at the beginning of disc or media	
	Mixed−CD Playback	Supported setting of available CD−DA track by TOC information	
		Supported setting all CD−DA track available	
		Supported setting of CD−ROM track with mute playback or skip to next track	
	Other	Supported clear command for media analysis information	
	High Frequency Correction	Selectable high frequency correction ON or OFF Supported “MP3”, “WMA” and “AAC”	

Table 7. FUNCTIONS FOR READOUT INFORMATION 1

Item	Function	Description	
Information	Get Firmware Version	Sequencer version	Supported
		Audio decoder version	Supported
		Model name	Supported
		Sequencer update firmware version	Supported
	Get Total Media File	Total number of folder	Supported
		Total number of file	Supported
		File format notification	File format notification that exists in the media
		Media Identification code	USB only
		Number of parent folder	For supporting folder and file browser function, supported “Get folder & file name command” for getting the name of specified folder and specified file
		Number of child folders within the folder	
		Total number of files within the folder	
		Number of 1st file within the folder	
		Number of big brother folder	
		Number of little brother folder	
		Number of least brother folder	
	Get Current Media Status	CD−DA Status	Status of CD−DA media
		CD−ROM Status	Status of CD−ROM media
		USB Status	Status of USB device connected to USB port
		iPod Status	Status of iPod connected to USB port
		SD Status	Status of SD connected to SD port
		BTA Status	Status of Bluetooth audio
		BTP Status	Status of Bluetooth phone
		Error Status	Error status of each media
		Track or File Status	Track or file type that is current played
		Function Status	Status of repeat and shuffle playback
		Play order Status	Current Play order
		Media current Status	Status of current media
		iPod certification Status	Status of iPod certification
		Update mode Status	Status of self−update mode
	Get Current Audio File Information	Format	MPEG1, MPEG2, MPEG2.5
			Layer2, Layer3
			WMA
			AAC
		TAG status	MP3 ID3 Version1.x, 2.2, 2.3, 2.4
			WMA character information available
			AAC character information available
		Sampling frequency	8 kHz to 48 kHz
		Channel Mode	Stereo, Joint Stereo, Dual, Mono
		Bit rate [kbps]	BCD[MSB], BCD[LSB]
		Audio File End Time	BCD[Hour], BCD[Minute], BCD[Second] End point play time of audio file

Table 8. FUNCTIONS FOR READOUT INFORMATION, FILE READ, AND IPOD

Item	Function	Description	
Text Information	Get Current Media Text Data	File name of MP3, WMA, AAC File	
		Folder name	
		“Title” of CD−TEXT, MP3, WMA, AAC File	
		“Artist name” of CD−TEXT, MP3, WMA, AAC File	
		“Album name” of CD−TEXT, MP3, WMA, AAC File	
		“Album artist name” of CD−TEXT	
		“Year” of MP3, WMA, AAC File	
		“Comment” of MP3, WMA, AAC File	
		“Genre” of MP3, WMA, AAC File	
	Get Folder & File Name	Folder name by specifying folder number	
		File name of MP3, WMA, AAC File by specifying serial number	
		File name of MP3, WMA, AAC File by specifying folder number and file number	
File read	Get File Data	Reads specified file data	
Apple® Accessory Interface	Accessory Authentication	Compliant with iAP2 Supported certification based on iAP2	
	Accessory Interface Specification Features	Device Power	Supported
		HID Media Playback Remote	Supported
		Now Playing Update	Supported
		External Accessory Protocol	Supported
		USB Device Mode Audio	Supported
	HID Media Playback Remote	Send Remote Key	Play, Pause, Play/Pause, Next track, Previous track, FF, REW
	Now Playing Update	Playback Status	Supported
		Playback Elapsed Time In Milliseconds	Supported
		Play back Queue Index	Supported
		Play back Queue Count	Supported
		Playback Shuffle Mode	Supported
		Playback Repeat Mode	Supported
	Media Item Attributes	Media Item Title	Supported
		Media Item Playback Duration In Milliseconds	Supported
		Media Item Album Title	Supported
		Media Item Artist	Supported

Table 9. FUNCTIONS FOR BLUETOOTH AUDIO

Item	Function	Description	
Bluetooth General	Version	Bluetooth. 5.1	
	Pairing	Secure simple auto pairing	Supported
		Inquiry	Supported multiple devices
		PIN code	Supported (Default off)
		Link key	Max 8
		BD address of remote device	Supported
		iAP2 Out−of−Band Bluetooth Pairing	Supported
		NFC	Supported
	Connected Device	A2DP, AVRCP profile device HFP, PBAP profile device	Max 2 devices (Supported to connect A2DP device, HFP device separately)
	Stack	HCI, L2CAP, RFCOMM	Supported
	Profile	A2DP ver. 1.3	Supported for Bluetooth Audio
		AVRCP ver. 1.6	Supported for Bluetooth Audio operation application
		HFP ver. 1.7	Supported for Bluetooth Phone (Hands−free)
		SPP ver. 1.2	Supported
		PBAP ver. 1.2	Supported for Bluetooth Phone Book application
	Setting and Display Name	Local name	Max 48 bytes
		Remote device name	Max 48 bytes
		Connected device name	Max 48 bytes
Bluetooth Audio	Codec	SBC	Supported
		AAC	Supported
	Operation	Play	Supported
		Pause	Supported
		Skip track	Supported
		FF, REW	Supported
		Skip Album	Supported
		Repeat Play	Supported
		Shuffle Play	Supported
		Above function depends on connected Bluetooth device	
	Display	Title, Artist, Album	Supported
		Play time	Supported
		Track number	Supported
		Playback status	Supported
		Above function depends on connected Bluetooth device	

Table 10. FUNCTIONS FOR BLUETOOTH HANDS−FREE

Item	Function	Description	
Bluetooth Hands−free	Bandwidth	NBS	Supported
		WBS	Supported
	Operation	HF answer Call (Answer)	Supported
		HF hang up (Terminate)	Supported
		HF redial (Redial)	Supported
		Dial number	Supported
		Reject	Supported
		Hands−free audio Link	Supported
		AT command	Supported
		Get Battery and Signal status	Supported
		Get Network carrier name	Max 48 bytes
		Select ring tone	Inside DSP or Hands−free device ring tone
	NC (Noise Cancellation) and EC (Echo Cancellation)	NC and EC ON or OFF	Supported, for telephone call
		Only NC ON or OFF	Supported, for voice recognition
		Setting NC or EC parameter	Supported
		Learning EC ON, OFF	Supported
		Reload EC learning data	Supported, required after DSP reset
		Setting mic Gain	Supported
Bluetooth Phone Book	Operation	Select vCard folder	Supported
		Read vCard list data	Supported, read data from current folder
		Read vCard entry data	Supported, read phone number
	Folder Information	Telecom	Supported
		SIM1	Supported
		SIM2	Supported
		Phone book	Supported
		Outgoing call history	Supported
		Incoming call history	Supported
		Call history	Supported
		Missed call history	Supported

Table 11. FUNCTIONS FOR AUDIO

Item	Function	Description	
Audio	Select Input Source	Analog audio source	Supported, with ASS Gain setting
		Digital audio source	Supported, by using 3 wires
		Internal DSP audio	Supported, such as USB media play
		Supported mute control, GPIO selection	
	Select Output Source	Electronic volume output	Supported
		DOUT (S/PDIF) output	Supported, it has some limitation
		Digital 3 lines output	Supported
	Electronic Volume Control	Write EVR Gain	Supported, direct setting of each EVR value with smoothing
		Select Volume Step	Supported, select index value of Volume setting with smoothing
		Select BAL & FAD Step	Supported, select index value of Balance and Fader with smoothing
	Equalizer Band	Total 22 bands supported (All 22 BAND EQ can be set arbitrarily)	
		Stereo 1 channel mode	22 bands
		Stereo 2 channel mode *	11 bands
	Beep Out *	4 channel (Stereo 2 channel)	
	Mixing *	2 channel (Stereo 1 channel)	
	Time Alignment	6 channel	
		Up to 21 ms. delay at F_S = 192 kHz	
	KARAOKE	Cancellation of vocal voices	

* Optional functions

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