FEATURES

- Video Decoder
  - Supports NTSC, PAL and SECAM video input formats
  - 2D NTSC and PAL comb-filter for Y/C separation of CVBS input
  - Multiple CVBS and S-video inputs
  - Supports Closed-caption and V-chip
  - Built-in anti-aliasing filter for analog-front-end
  - ACC, AGC, and DCGC (Digital Chroma Gain Control)
- Analog Input
  - Supports RGB input format from PC, camcorders and GPS
  - Supports YCbCr inputs from conventional video source and HDTV
  - Supports video input 480i, 480p, 576i, 576p, 720p, 1080i; RGB input resolution in 640x480, 800x480, 800x600(SVGA), and 1024x768(XGA)
  - 3-channel low-power 10-bit ADCs integration for YCbCr or CVBS or S-Video; ADC frequency up to 86MHz
  - 3-channel 8-bit ADC for navigator RGB input; ADC frequency up to 86MHz
  - Supports RGB composite sync input (CSYNC), SOY, SOG, HSYNC, and VSYNC
  - On-chip clock synthesizer and PLL
  - Auto-position adjustment, auto-phase adjustment, auto-gain adjustment, and auto-mode detection
- Digital Video Input
  - Supports ITU-R BT.656 digital video input and progressive ITU-R BT.656 compatible input format
  - Supports ITU-R BT.601 8/16-bit digital video input
  - Supports digital 666/888 input
- Digital/Analog Output
  - 3-channel low-power 8-bit DAC for RGB output, dynamic range 0.1-4.9 V
- Video Processing
  - 2-D video de-interlacer
  - Edge-oriented adaptive algorithm for smooth low-angle edges
  - PIP/POP with programmable size and location, supports multi-video applications
  - 3-D video noise reduction for SDTV and 2-D video noise reduction for HDTV input
  - Brightness, contrast, saturation, and hue adjustment
  - 9-tap programmable multi-purpose FIR (Finite Impulse Response) filter
  - Differential 3-band peaking engine
  - Vertical peaking
  - Luminance Transient Improvement (LTI)
  - Chrominance Transient Improvement (CTI)
  - Black Level Extension (BLE)
  - White Level Extension (WLE)
  - Favor Color Compensation (FCC)
  - 3-channel gamma curve adjustment
  - Independent 6 color of saturation, hue, and brightness control
- Digital PWM Controller
  - Integrated general purpose digital PWM control loop
  - Programmable startup operating frequency and period with output voltage regulation
  - Programmable output current regulation; 40KHz~70KHz switching frequency, sync. to HSYNC possible
  - Burst-mode or continuous-mode for output current regulation; 150Hz~300Hz burst-mode frequency, sync. to VSYNC possible
  - Programmable protection level for input voltage and fault detection
- LVDS/TTL Panel Interface
  - Supports up to 8-bit single link LVDS
  - Supports up to 8-bit TTL panel output with TCON
  - Supports digital panels up to 800x480,800x600 (SVGA), 960x540(QHD) and 1366x768(WXGA)

- Programmable 24-bit (RGB888) digital output with HSYNC/VSYNC or 18-bit (RGB666) digital output with TCON
- Supports various displaying modes
- Supports horizontal panorama scaling

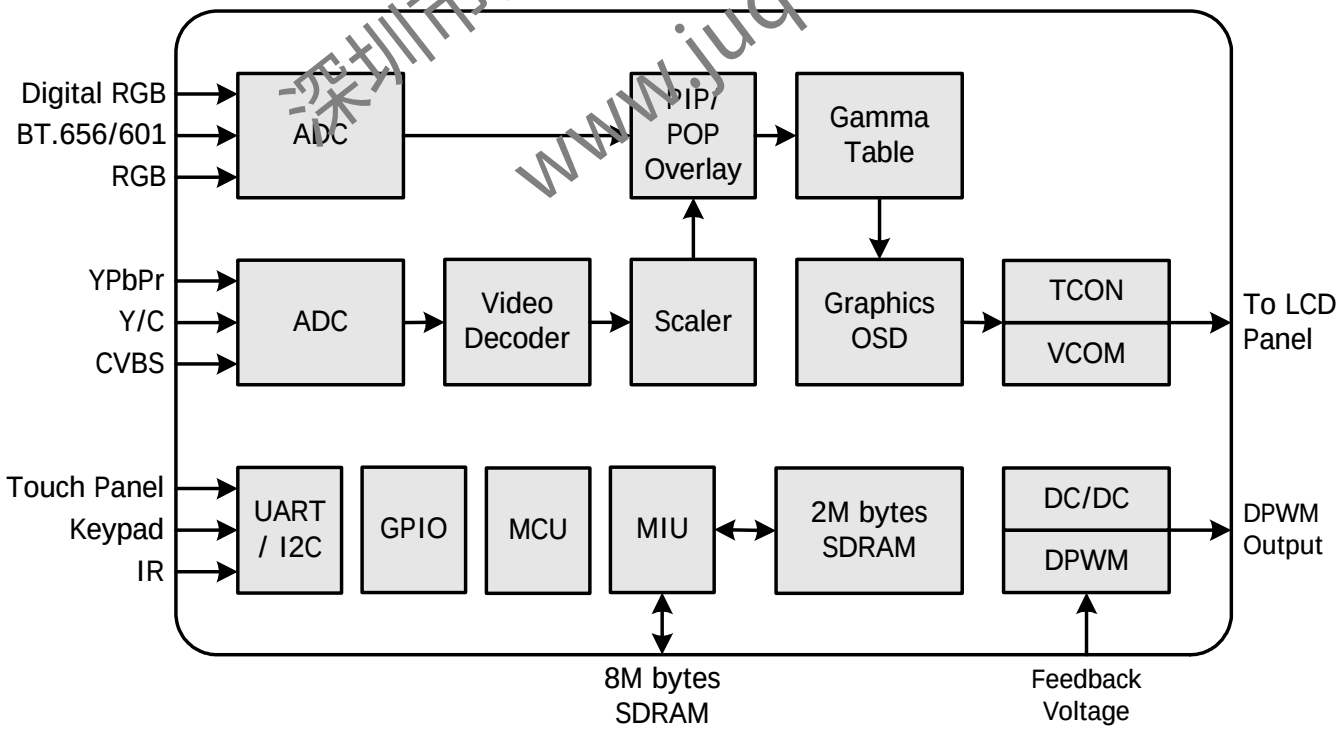
■ 2D Graphics Engine

- Line draw, rectangle draw/fill and color expansion acceleration
- 16/256-color graphic OSD with two non-overlapping display windows
- Graphic display path of 720x576 with anti-flicker filter
- One video display path of 720x576 with H/V scaling from 0.5 to 2

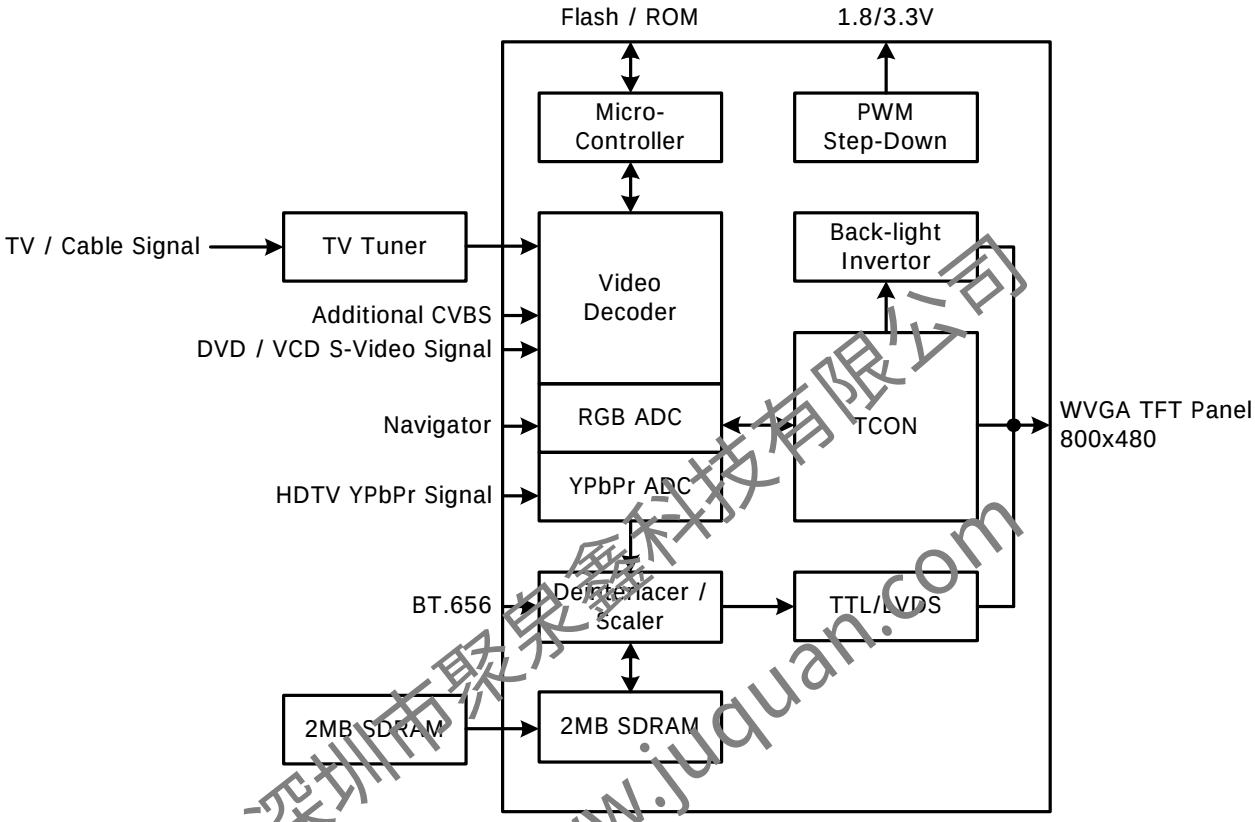
■ Miscellaneous

- Built-in MCU
- I^2C bus interface for configuration setup
- Supports 10-bit gamma table
- Supports H/V sync out from CVBS for old NAVI system
- Built-in step-down PWM circuits for input 1.8V and 3.3V
- Built-in step-up boost circuits (for VGL and VGH)
- DC/DC level adjustment circuit
- 16-bit data bus for external SDR DRAM frame buffer
- Supports up to 8MB external SDR DRAM interface
- Supports 1Mbx16 embedded SDR DRAM
- Spread spectrum clocks
- Optional 3.3V/5V TCON pads with programmable driving current
- 216-pin LQFP package

BLOCK DIAGRAM



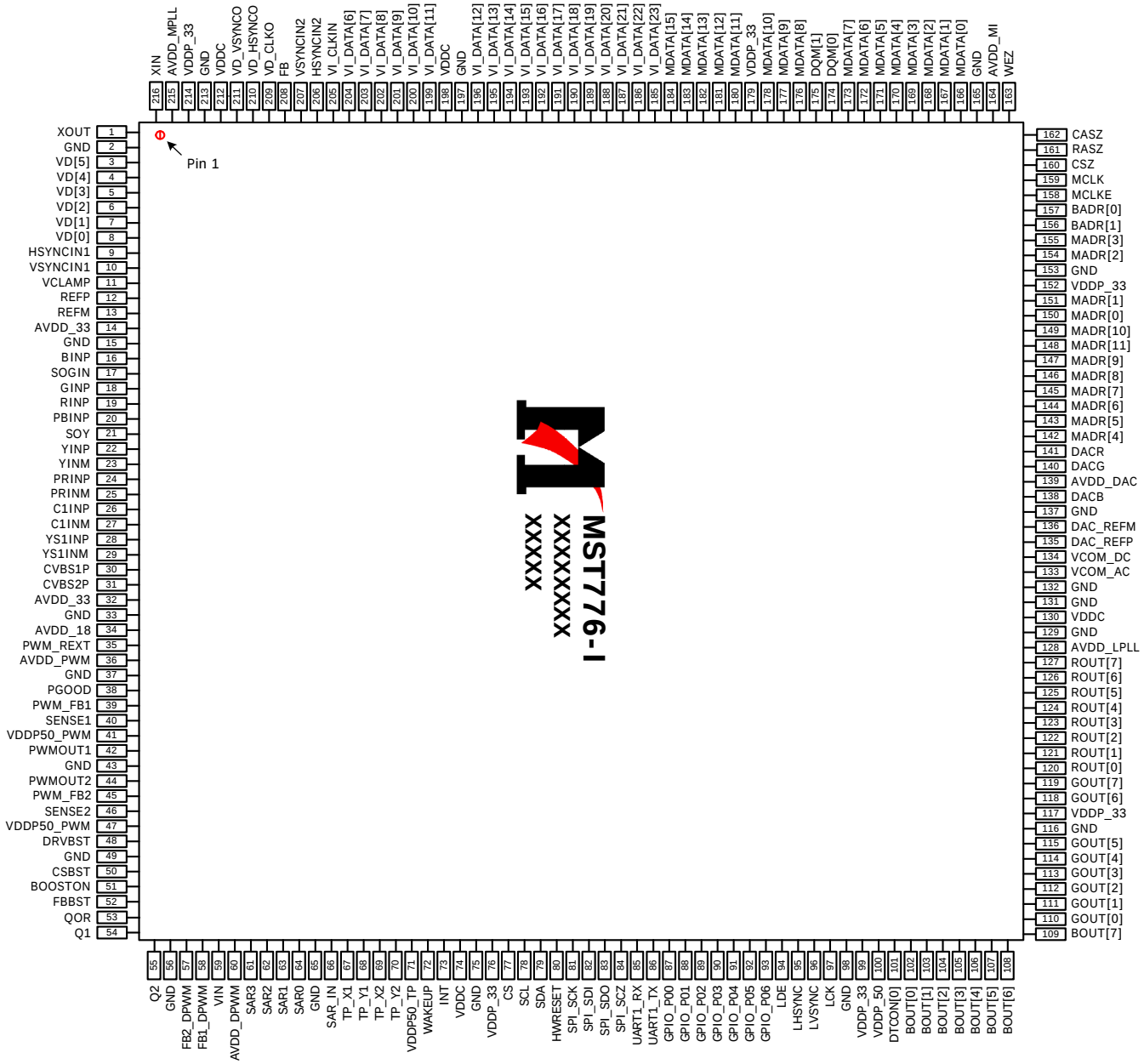
SYSTEM APPLICATION DIAGRAM



GENERAL DESCRIPTION

The MST776-I is a high quality ASIC for Car TV and portable DVD player applications. It receives analog NTSC/PAL/SECAM CVBS and S-Video inputs from TV tuners, DVD or VCR sources, including weak and distorted signals, as well as analog RGB input from GPS systems. Automatic gain control (AGC) and 10-bit 3-channel A/D converters provide high resolution video quantization. With automatic video source and mode detection, users can easily switch and adjust variety of signal sources. Multiple internal adaptive PLLs precisely extract pixel clock from video source and perform sharp color demodulation. PIP/POP is provided for multimedia applications. Built-in line-buffer supports adaptive 2-D comb-filter, 2-D sharpening, and synchronization stabler in a condensed manner. The output format of MST776-I supports 8-bit TTL or LVDS digital TFT-LCD modules.

PIN DIAGRAM (MST776-I)



Note: This pin diagram is based on 8-bit TTL output.

PIN DESCRIPTION

MCU Interface

Pin Name	Pin Type	Function	Pin
SAR3	Analog Input	SAR Low Speed ADC Input 3	61
SAR2	Analog Input	SAR Low Speed ADC Input 2	62
SAR1	Analog Input	SAR Low Speed ADC Input 1	63
SAR0	Analog Input	SAR Low Speed ADC Input 0	64
SAR_IN	Analog Input	SAR Low Speed ADC Input for Keypad	66
SPI_SCK	Output	SPI Flash Serial Clock	81
SPI_SDI	Output	SPI Flash Data Input	82
SPI_SDO	Input w/ 5V-tolerant	SPI Flash Data Output	83
SPI_SCZ	Output	SPI Flash Chip Select	84
GPIO_P00-GPIO_P06	I/O w/ 5V-tolerant	General Purpose Input/Output; 4mA driving strength	87-93
INT	Input	External Interrupt Input	73
CS	Input w/ 5V-tolerant	3-Wire Serial Bus Chip Select; active high	77
SCL	Input w/ 5V-tolerant	3-Wire Serial Bus Clock Input	78
SDA	I/O w/ 5V-tolerant	3-Wire Serial Bus Data; 4mA driving strength	79
HWRESET	Schmitt Trigger Input w/ 5V-tolerant	Hardware Reset; active high	80

Analog Video Interface

Pin Name	Pin Type	Function	Pin
VCLAMP		CVBS/YC Mode Clamp Voltage Bypass	11
REFP		Internal ADC Top De-coupling Pin	12
REFM		Internal ADC Bottom De-coupling Pin	13
PRINP	Analog Input	Analog Pr Input of HDTV	24
PRINM	Analog Input	Reference Ground for Analog Pr Input of HDTV	25
PBINP	Analog Input	Analog Pb Input of HDTV	20
SOY	Analog Input	Sync-on-Y Slicer Input	21
YINP	Analog Input	Analog Y Input of HDTV	22
YINM	Analog Input	Reference Ground for Analog Y Input of HDTV	23
BINP	Analog Input	Analog B Input of VGA	16
SOGIN	Analog Input	Sync-on-Green Slicer Input	17
GINP	Analog Input	Analog G Input of VGA	18

Pin Name	Pin Type	Function	Pin
RINP	Analog Input	Analog R Input of VGA	19
C1INP	Analog Input	Analog Chroma Input for TV S-Video1 / Analog Composite Input of TV CVBS4	26
C1INM	Analog Input	Reference Ground for Analog Chroma Input of TV S-Video1 / Analog Composite Input of TV CVBS4	27
YS1INP	Analog Input	Analog Luma Input of TV S-Video1 / Analog Composite Input of TV CVBS3	28
YS1INM	Analog Input	Reference Ground for Analog Luma Input of TV S-Video1 / Analog Composite Input of TV CVBS3	29
CVBS1P	Analog Input	Analog Composite Input for TV CVBS1	30
CVBS2P	Analog Input	Analog Composite Input for TV CVBS2	31
HSYNCIN1/ CSYNC	Schmitt Trigger Input w/ 5V-tolerant	HSYNC / Composite Sync for GPS RGB Input 1	9
VSYNCIN1	Schmitt Trigger Input w/ 5V-tolerant	VSYNC	10
HSYNCIN2	Schmitt Trigger Input w/ 5V-tolerant	HSYNC for YPbPr/Digital RGB Input 2	206
VSYNCIN2	Schmitt Trigger Input w/ 5V-tolerant	VSYNC for YPbPr/Digital RGB Input 2	207
FB	Schmitt Trigger Input w/ 5V-tolerant	Fast Blank for GPS RGB Input	208
VD_HSYNCO	Output	Video Decoder Horizontal Sync Output for GPS Synchronization	210
VD_VSYNCO	Output	Video Decoder Vertical Sync Output for GPS Synchronization	211
VD_CLKO	Output	Video Decoder Display Clock Output for GPS Synchronization	209
REFP_DAC		DAC Top Reference Voltage Decoupling Cap. 1uF to Ground	135
REFM_DAC		DAC Bottom Reference Voltage Decoupling Cap. 1uF to Ground	136
DACB	Analog Output	Analog Video B Channel Output	138
DACG	Analog Output	Analog Video G Channel Output	140
DACR	Analog Output	Analog Video R Channel Output	141

Digital Video Interface

Pin Name	Pin Type	Function	Pin
VI_CLKIN	Input w/ 5V-tolerant	Digital Video Input Clock	205
VI_DATA[23:0]	Input w/ 5V-tolerant	Digital Video Input Data [23:0]	185-196, 199-204, 3-8
ROUT[7:0]	Output w/ Pull-down Resistor	Red Channel Output	127-120
GOUT[7:0]	Output w/ Pull-down Resistor	Green Channel Output	119, 118, 115-110
BOUT[7:0]	Output w/ Pull-down Resistor	Blue Channel Output; programmable	109-102
DTCON[0]	Output	TCON Output	101
LCK	Output w/ Pull-down Resistor	LCD Output Clock; 6mA driving strength	97
LVSYNC	Output	LCD VSYNC; 6mA driving strength	96
LHSYNC	Output	LCD HSYNC; 6mA driving strength	95
LDE	Output	Display Enable Output	94

Digital PWM Interface

Pin Name	Pin Type	Function	Pin
QOR	Output	Combined DPWM Output 1 and 2	53
Q1	Output	DPWM Output 1	54
Q2	Output	DPWM Output 2	55
FB2_DPWM	Analog Input	Input for 2nd Feedback Loop	57
FB1_DPWM	Analog Input	Input for 1st Feedback Loop	58
VIN	Analog Input	System Input Voltage Detection	59

Switching Power and PWM Interface

Pin Name	Pin Type	Function	Pin
PWM_REXT	Analog Input	External Resistor to GND, 100k ohm Resistor for Internal Reference Current	35
PGOOD	Output	Power Good Detector	38
PWM_FB1	Analog Input	Error Voltage Feedback Input Pin for PWM1; voltage = 1.0V	39
SENSE1	Analog Input	Sense Circuit Connection for PWM1	40
PWMOUT1	Output	Switching Pulse Output for 3.3V DC-DC Converter	42

Pin Name	Pin Type	Function	Pin
PWMOUT2	Output	Switching Pulse Output for 1.8V DC-DC Converter	44
PWM_FB2	Analog Input	Error Voltage Feedback Input Pin for PWM2; voltage = 1.0V	45
SENSE2	Analog Input	Sense Circuit Connection for PWM2	46
DRVBST	Analog Output	Boost Converter Driving Output	48
CSBST	Analog Input	Boost Converter Current Sense	50
BOOSTON	Analog Output	Boost Converter On/Off Switch Control	51
FBBST	Analog Input	Boost Converter Output Voltage Feedback	52

DRAM Interface

Pin Name	Pin Type	Function	Pin
BADR[1:0]	Output	DRAM Memory Bank Address	156, 157
CASZ	Output	Column Address Strobe; active low	162
DQM[1:0]	Output	Data Mask for Low Byte; active high	175, 174
DQS[3:0]	I/O	Data Strobe	
MADR[11:0]	Output	DRAM Memory Address	148, 149, 147-142, 155, 154, 151, 150
MCLK	Output	DRAM Memory Positive Differential Clock	159
MCLKE	Output	DRAM Memory Clock Enable	158
MDATA[15:0]	I/O	DRAM Memory Data Bus	184-180, 178-176, 173-166
CSZ	Output	Chip Select; active low	160
RASZ	Output	Row Address Strobe; active low	161
WEZ	Output	Write Enable; active low	163

Touch Panel Interface

Pin Name	Pin Type	Function	Pin
TP_X1	Analog I/O	Touch Panel X-axis Input/Output 1	67
TP_Y1	Analog I/O	Touch Panel Y-axis Input/Output 1	68
TP_X2	Analog I/O	Touch Panel X-axis Input/Output 2	69
TP_Y2	Analog I/O	Touch Panel Y-axis Input/Output 2	70

UART Interface

Pin Name	Pin Type	Function	Pin
UART1_RX	Input w/5V-tolerant	Universal Asynchronous Receiver 1	85
UART1_TX	I/O w/5V-tolerant	Universal Asynchronous Transmitter 1	86

VCOM Interface

Pin Name	Pin Type	Function	Pin
VCOM_AC	Analog Output	Reference AC Voltage Output for Common Amplifier	133
VCOM_DC	Analog Output	Reference DC Voltage Output for Common Amplifier	134

Misc. Interface

Pin Name	Pin Type	Function	Pin
XIN	Analog Input	Crystal Oscillator Input	216
XOUT	Analog Output	Crystal Oscillator Output	1
WAKEUP	Input	Device Wake Up	72

Power Pins

Pin Name	Pin Type	Function	Pin
AVDD_33	3.3V Power	Analog Power	14, 32
AVDD_18	1.8V Power	Analog Power	34
AVDD_PWM	5V Power	Analog PWM Power	36
AVDD_DPWM	3.3V Power	DPWM Power	60
AVDD_LPLL	3.3V Power	LPLL Power	128
AVDD_DAC	5V Power	DAC Power	139
AVDD_MI	3.3V Power	Memory Power	164
AVDD_MPLL	3.3V Power	MPLL Power	215
VDDC	1.8V Power	Digital Core Power	74, 130, 198, 212
VDDP50_PWM	5V Power	PWM Power	41, 47
VDDP50_TP	5V Power	Touch Panel Power	71
VDDP_50	3.3V/5V Power	Digital Input/Output Power for TCON	100
VDDP_33	3.3V Power	Digital Input/Output Power	76, 99, 117, 152, 179, 214
GND	Ground	Ground	2, 15, 33, 37, 43, 49, 56, 65, 75, 98, 116, 129, 131, 132, 137, 153, 165, 197, 213

ELECTRICAL SPECIFICATIONS

Analog Interface Characteristics

Parameter	MST776-I			Unit
	Min	Typ	Max	
Resolution		10		Bits
ANALOG INPUT				
Input Voltage Range				
Minimum		0.5		V p-p
Maximum		1.5		V p-p
Input Bias Current			1	µA
SWITCHING PERFORMANCE				
Maximum Conversion Rate		86		MSPS
Minimum Conversion Rate		12		MSPS
Maximum PLL Clock Rate		86		MHz
Minimum PLL Clock Rate		10		MHz
PLL Jitter		TBD		ps p-p
Sampling Phase Tempco		15		ps/°C
DIGITAL INPUTS				
Input Voltage, High (V_{IH})	0.7 VDDP			V
Input Voltage, Low (V_{IL})			0.8	V
Input Current, High (I_{IH})			-1.0	µA
Input Current, Low (I_{IL})			1.0	µA
Input Capacitance		5		pF
DIGITAL OUTPUTS				
Output Voltage, High (V_{OH})	VDD - 0.1			V
Output Voltage, Low (V_{OL})			0.1	V

Notes
1. With Timing Interval Analyzer (TIA) measurement
Specifications are subjected to change without notice.

Absolute Maximum Ratings

Parameter	Symbol	Min	Typ	Max	Units
5.0V Supply Voltages	V_{VDD_50}	-0.3		5.5	V
3.3V Supply Voltages	V_{VDD_33}	-0.3		3.6	V
1.8V Supply Voltages	V_{VDD_18}	-0.3		1.98	V
Input Voltage (5V tolerant inputs)	$V_{IN5Vtol}$	-0.3		5.0	V
Input Voltage (non 5V tolerant inputs)	V_{IN}	-0.3		V_{VDD_33}	V
Ambient Operating Temperature	T_A	-40		85	°C
Storage Temperature	T_{STG}	-40		150	°C
Junction Temperature	T_J			150	°C
Thermal Resistance (Junction to Air) Natural Conversion	θ_{JA}		TBD		°C/W
Thermal Resistance (Junction to Case) Natural Conversion	θ_{JC}		TBD		°C/W

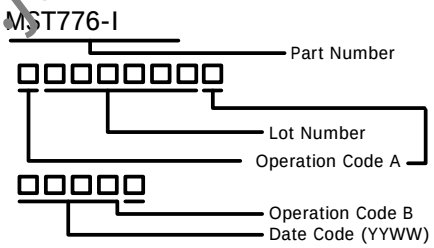
Note: Stresses above those listed in Absolute Maximum Ratings may cause permanent damage to the device. This is a stress rating only and does not imply functional operation of the device. Exposure to absolute maximum ratings for extended periods may affect device reliability.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
MST776-I	-40°C to +85°C	LQFP	216
MST776-I-LF	-40°C to +85°C	LQFP	216

Note: Product suffix "-LF" represents lead-free version.

MARKING INFORMATION



DISCLAIMER

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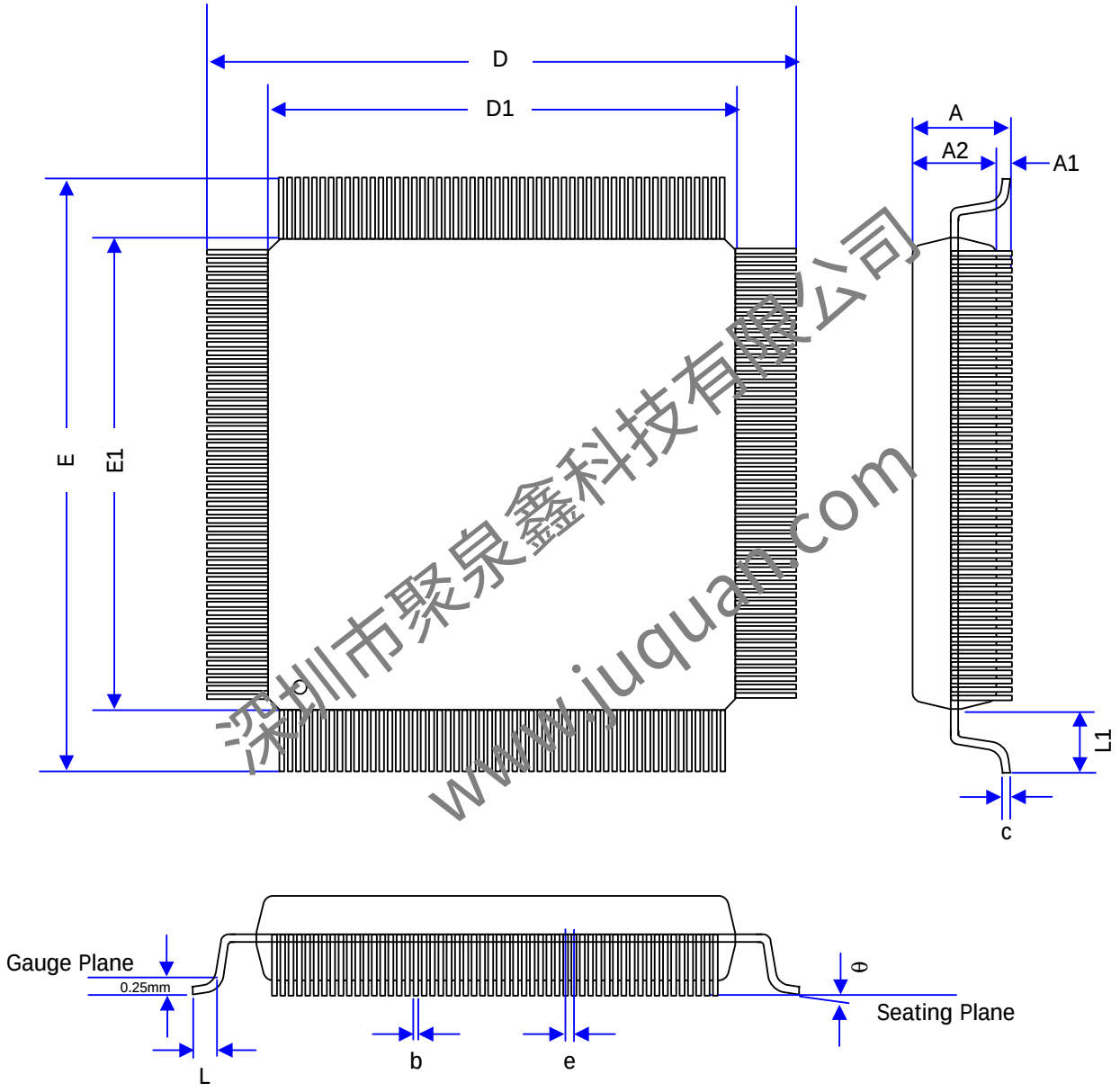
Electrostatic charges accumulate on both test equipment and human body and can discharge without detection. MST776-I comes with ESD protection circuitry; however, the device may be permanently damaged when subjected to high energy discharges. The device should be handled with proper ESD precautions to prevent malfunction and performance degradation.

REVISION HISTORY

Document	Description	Date
MST776-I_pb_v01	• Initial release	Nov 2007

MECHANICAL DIMENSIONS



Symbol	Millimeter			Inch		
	Min.	Nom.	Max.	Min.	Nom.	Max.
A	-	-	1.60	-	-	0.063
A1	0.05	-	0.15	0.002	-	0.006
A2	1.35	1.40	1.45	0.053	0.055	0.057
D	26.00			1.024		
D1	24.00			0.945		
E	26.00			1.024		
E1	24.00			0.945		

Symbol	Millimeter			Inch		
	Min.	Nom.	Max.	Min.	Nom.	Max.
θ	0°	3.5°	7°	0°	3.5°	7°
L	0.45	0.60	0.75	0.018	0.024	0.030
L1	1.00 REF.			0.039 REF.		
b	-	0.18	-	-	0.007	-
c	-	0.08	-	-	0.003	-
e	0.40 BSC			0.016 BSC		