OKI

MSM6679AL-110
Voice Recognition Processor

FIRST EDITION

ISSUE DATE: Nov. 1998

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OKI Semiconductor

This version: Nov. 1998

MSM6679AL-110

SI/SD Voice Recognizer, Recorder/Player, and Speech Synthesizer

GENERAL DESCRIPTION

The MSM6679AL-110 Voice Recognition Processor (VRP) is a slave-mode device that performs five func-tions: speaker-independent (SI) voice recognition, speaker-dependent (SD) voice recognition, solid-state sound recording, sound playback, and speech synthesis. The highly integrated device also provides an on-chip memory controller, Flash memory interface, analog data conversion, Oki speech synthesizer interface, and pulse width modulation (PWM) sound output.

For SI recognition, the MSM6679AL-110 contains a vocabulary template in external memory. Pretrained SI vocabularies eliminate the need for laborious training, as usually required by SD products. The memory requirements are dependent on the size of the vocabulary. The MSM6679AL-110 can tolerate background noise, while providing high recognition accuracy. In its designated operating environment, the device achieves a typical recognition accuracy of >95% (using an Oki-defined test procedure).

For SD recognition, the MSM6679AL-110 stores SD vocabulary templates, as defined by the user, in external SRAM. The MSM6679AL-110 can create SD vocabularies of up to 61 words each, with each word using approximately 50 bytes.

In addition to providing voice recognition capabilities, the MSM6679AL-110 integrates a solid-state recorder/player, speech synthesis functions, and a tone generator. ADPCM recording/playback provides high quality sound and efficient memory utilization. The MSM6679AL-110 can respond to spoken com-mands, verbally or with tones, via an on-chip speech synthesizer and tone generator. For larger speech-synthesis requirements, the MSM6679AL-110 also provides a glueless MSM665x control interface for off-chip speech synthesis.

The MSM6679AL-110 can interface to any application or personal computer via a serial interface through an open, device-independent serial mode API (SMAPI). To accelerate code development, Oki supplies an evaluation kit, and assembly and C language programs for this product.

The MSM6679AL-110 is a low power version of the MSM6679A-110.

Note: This device is intended for use in applications other than central office communication systems and central office switching systems.

FEATURES

- SI recognition
  - Up to 20 - 25 words in each vocabulary
  - Multiple vocabulary support
- SD recognition
  - Up to 61 words in each vocabulary
  - Multiple vocabulary support
- Speech synthesis
  - Up to 2.3-sec internal and 27.6-sec external speech synthesis on-chip; sample looping and concatenation allows even longer phrases.
  - On-chip controller for MSM665x speech synthesizer
  - Standard beep tone outputs
  - Pulse code modulation (PCM) and adaptive differential pulse code modulation (ADPCM) voice or sound-effect output
- Speech capture and playback
  - 28-kbps ADPCM speech compression
- Serial ASCII command interface
- 6944-Hz audio input sample rate for record and playback
- 10-kHz sample rate for voice recognition
- 200-msec recognition latency
- Flexible memory mapping for EPROM, FLASH, and SRAM
- 14.3182 MHz operation
- Package: 100-pin TQFP (TQFP100-P-1414-0.50-K)

FUNCTIONAL AND I/O DIAGRAMS

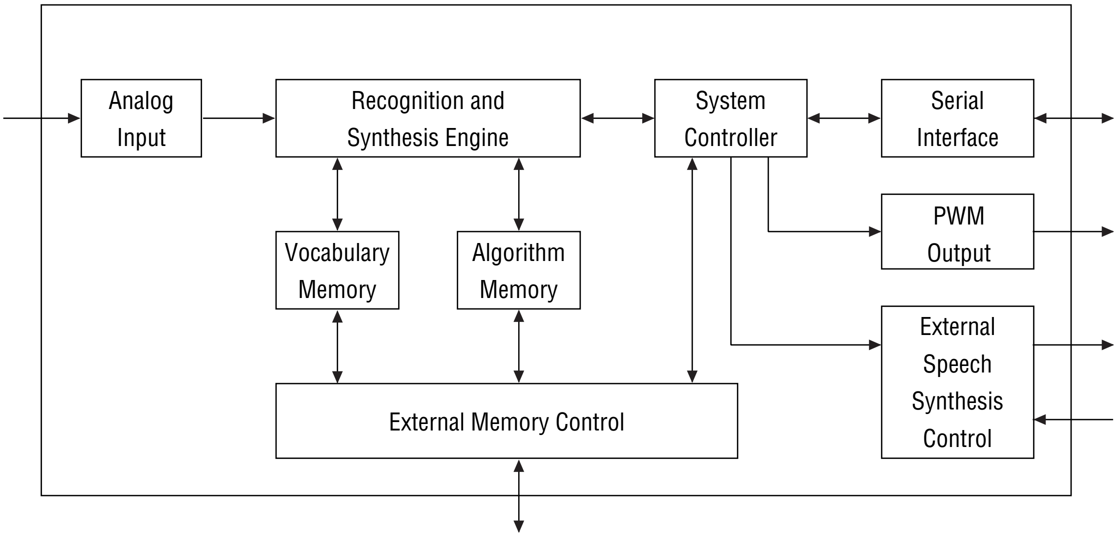

Analog Input
Recognition and Synthesis Engine
System Controller
Serial Interface
PWM Output
Vocabulary Memory
Algorithm Memory
External Speech Synthesis Control
External Memory Control

Figure 1. MSM6679AL-110 Block Diagram

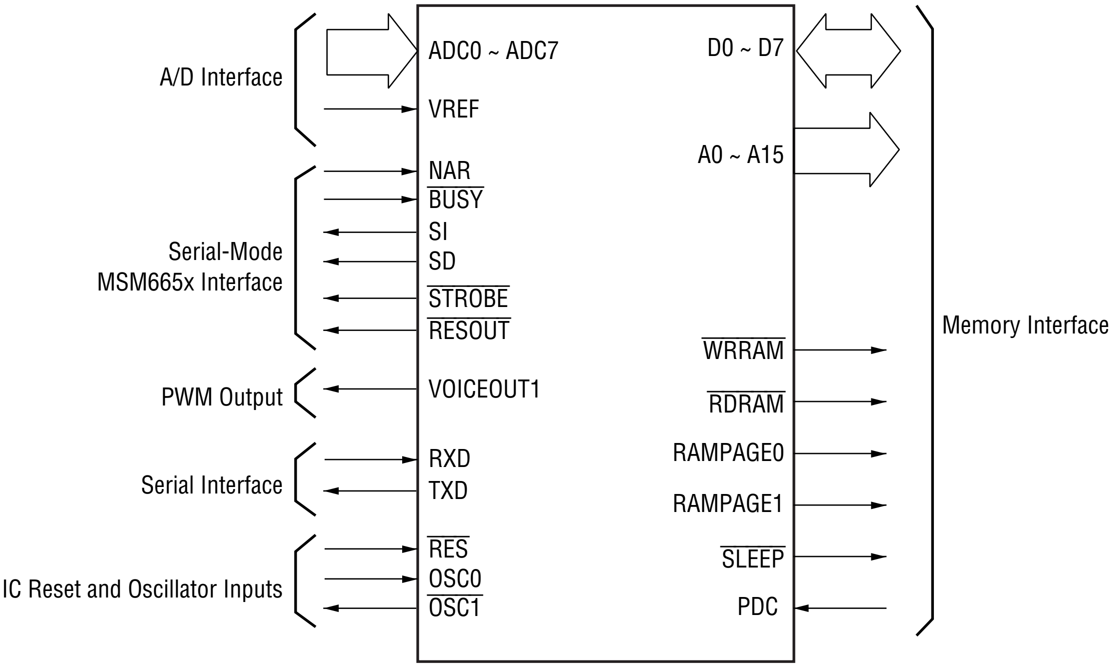
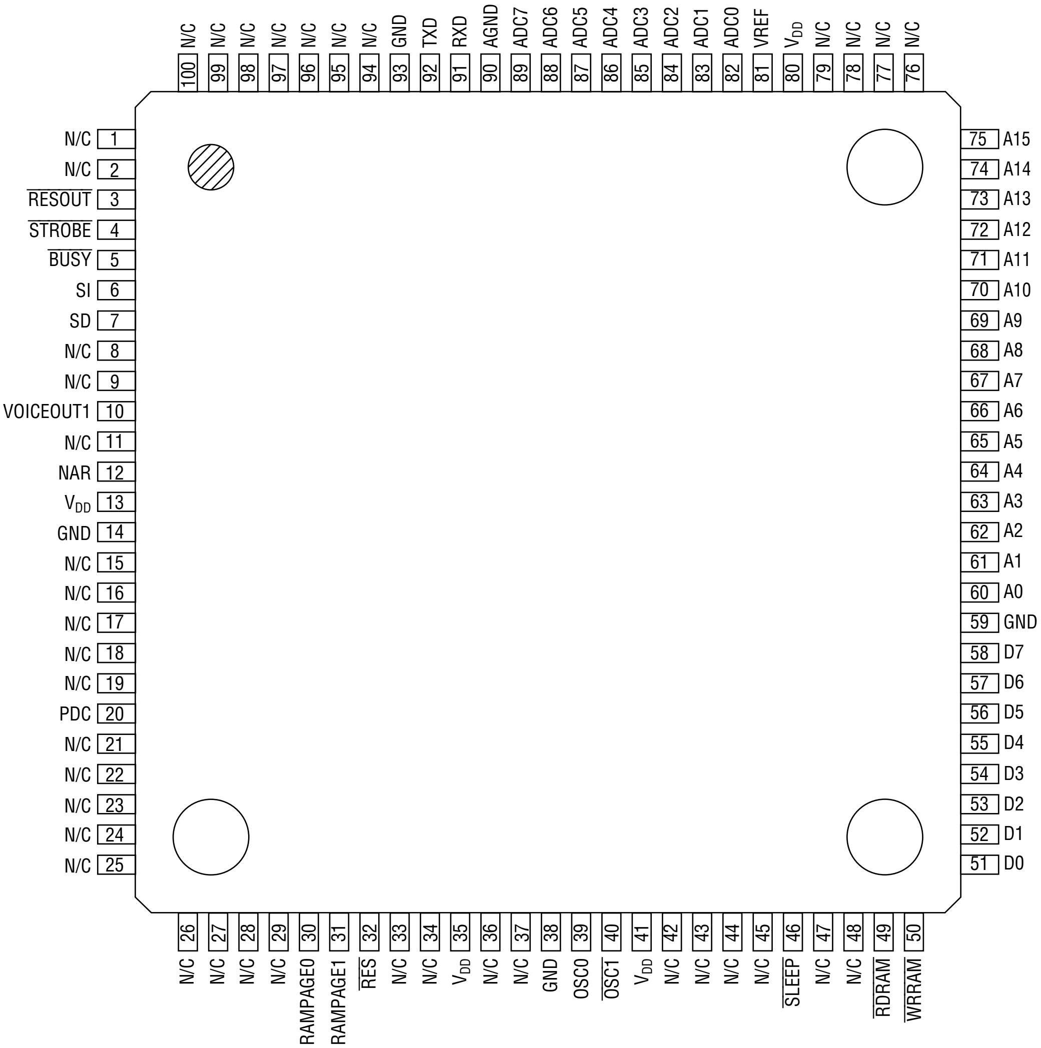

A/D Interface
ADC0 ~ ADC7
VREF
Serial-Mode MSM665x Interface
NAR
BUSY
SI
SD
STROBE
RESOUT
PWM Output
VOICEOUT1
Serial Interface
RXD
TXD
IC Reset and Oscillator Inputs
RES
OSC0
OSC1
D0 ~ D7
A0 ~ A15
WRRAM
RDRAM
RAMPAGE0
RAMPAGE1
SLEEP
PDC
Memory Interface

Figure 2. MSM6679AL-110 Logic Symbol



1 N/C
2 N/C
3 $\overline{RESOUT}$
4 $\overline{STROBE}$
5 $\overline{BUSY}$
6 SI
7 SD
8 N/C
9 N/C
10 VOICEOUT1
11 N/C
12 NAR
13 V_{DD}
14 GND
15 N/C
16 N/C
17 N/C
18 N/C
19 N/C
20 PDC
21 N/C
22 N/C
23 N/C
24 N/C
25 N/C
26 N/C
27 N/C
28 N/C
29 N/C
30 RAMPAGE0
31 RAMPAGE1
32 $\overline{RES}$
33 N/C
34 N/C
35 V_{DD}
36 N/C
37 N/C
38 GND
39 OSC0
40 $\overline{OSC1}$
41 V_{DD}
42 N/C
43 N/C
44 N/C
45 N/C
46 $\overline{SLEEP}$
47 N/C
48 N/C
49 $\overline{RDRAM}$
50 $\overline{WRRAM}$
51 D0
52 D1
53 D2
54 D3
55 D4
56 D5
57 D6
58 D7
59 GND
60 A0
61 A1
62 A2
63 A3
64 A4
65 A5
66 A6
67 A7
68 A8
69 A9
70 A10
71 A11
72 A12
73 A13
74 A14
75 A15
76 N/C
77 N/C
78 N/C
79 N/C
80 V_{DD}
81 VREF
82 ADC0
83 ADC1
84 ADC2
85 ADC3
86 ADC4
87 ADC5
88 ADC6
89 ADC7
90 AGND
91 RXD
92 TXD
93 GND
94 N/C
95 N/C
96 N/C
97 N/C
98 N/C
99 N/C
100 N/C

Figure 3. MSM6679AL-110 100-Pin TQFP Pinout

MSM6679AL-110 Alphabetic Pin List

Name	#	Name	#	Name	#	Name	#	Name	#	Name	#
A0	60	A10	70	ADC4	86	D4	55	RAMPAGE0	30	TXD	92
A1	61	A11	71	ADC5	87	D5	56	RAMPAGE1	31	V_{DD}	13, 35, 41, 80
A2	62	A12	72	ADC6	88	D6	57	$\overline{\text{RDRAM}}$	49		
A3	63	A13	73	ADC7	89	D7	58	$\overline{\text{RES}}$	32	VOICEOUT1	10
A4	64	A14	74	AGND	90	GND	14,38, 59,93	$\overline{\text{RESOUT}}$	3	VREF	81
A5	65	A15	75	$\overline{\text{BUSY}}$	5			RXD	91	$\overline{\text{WRRAM}}$	50
A6	66	ADC0	82	D0	51	NAR	12	SD	7		
A7	67	ADC1	83	D1	52	OSC0	39	SI	6		
A8	68	ADC2	84	D2	53	$\overline{\text{OSC1}}$	40	$\overline{\text{SLEEP}}$	46		
A9	69	ADC3	85	D3	54	PDC	20	$\overline{\text{STROBE}}$	4		

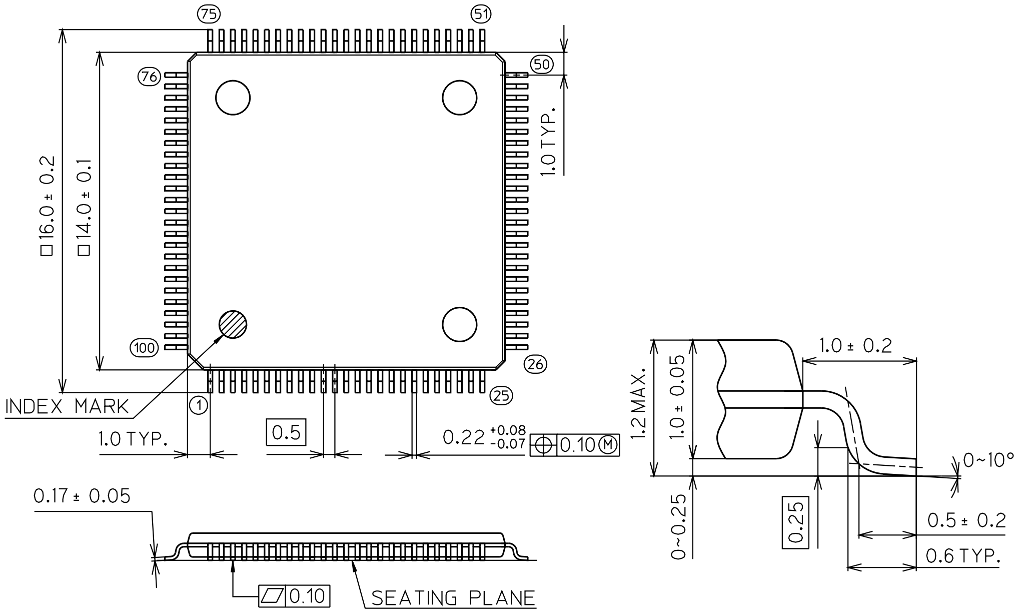

75
51
50
76
1.0 TYP.
□16.0 ± 0.2
□14.0 ± 0.1
100
26
INDEX MARK
1
25
1.0 TYP.
0.5
0.22 +0.08 -0.07
0.10 M
1.2 MAX.
1.0 ± 0.05
1.0 ± 0.2
0~10°
0~0.25
0.25
0.5 ± 0.2
0.6 TYP.
0.17 ± 0.05
0.10
SEATING PLANE

Figure 4. MSM6679AL-110 100-Pin Package Mechanical Drawing

PIN DESCRIPTIONS

Pin #	Pin Name	Signal Type	Description
1	NC	(do not connect)	Reserved. These pins are reserved for future used and must be left open.
2			
3	$\overline{\text{RESOUT}}$	Output	MSM665x Reaet. This pin provides a reset signal for an external speech synthesis engine.
4	$\overline{\text{STROBE}}$	Output	MSM665x Strobe. This output provides the LOAD signal for an external speech synthesizer.
5	$\overline{\text{BUSY}}$	Input	MSM665x Busy. When using an external MSM665x device, this pin monitors the MSM665x $\overline{\text{BUSY}}$ signal and connects directly to the MSM665x $\overline{\text{BUSY}}$ signal output.
6	SI	Output	MSM665x Serial Clock. This MSM6679AL-110 output connects to the MSM665x SI input. The SI pin is the MSM665x serial clock input pin.
7	SD	Output	MSM665x Serial Data. This MSM6679AL-110 output connects to the MSM665x SD input. The SD pin is the MSM665x serial data input pin.
8	NC	(do not connect)	Reserved. These pins are reserved for future use and must be left open.
9			
10	VOICEOUT1	Output	Voice Out. This pin is the PWM output for speech synthesis, voice sample playback, and voice prompts. An external integrator must be used to convert this to an analog signal.
11	NC	(do not connect)	Reserved. This pin is reserved for future use and must be left open.
12	NAR	Input	MSM665x Next Address Request. This pin signals to the MSM6679AL-110 that the external speech synthesis engine is ready for another command.
13	V_{DD}	Digital Power	Power.
14	GND	Digital Ground	Ground.
15	NC	Input	Reserved. These pins are reserved for future use and must be tied to VDD.
16			
17			
18	NC	(do not connect)	Reserved. This pin is reserved for future use and must be left open.
19	NC	Input	Reserved. This pin is reserved for future use and must be tied to VDD.
20	PDC	Input	Power down release. Power down mode is released by both edge of PDC signal.

Pin #	Pin Name	Signal Type	Description
21	NC	(do not connect)	Reserved. These pins are reserved for future use and must be left open.
22			
23			
24			
25			
26			
27			
28			
29			
30	RAMPAGE0	Output	RAM Page Select. These signals support selection of one out of four RAM pages. Each page is 64kbytes in size.
31	RAMPAGE1		
32	$\overline{\text{RES}}$	Input	MSM6679AL-110 Reset. External logic should assert this power-on reset signal LOW when power is applied to the MSM6679AL-110.
33	NC	Input	Reserved. These pins are reserved for future use and must be tied to VDD.
34			
35	V_{DD}	Digital Power	Power.
36	NC	Input	Reserved. These pins are reserved for future use and must be tied to VDD.
37			
38	GND	Ground	Ground.
39	OSC0	Input	Oscillator 0/External Clock. When the MSM6679AL-110 uses a crystal oscillator, this input is the oscillator input pin. The pin is then connected to one side of a crystal and load capacitor. When used with an external clock, the external clock is applied to this input.
40	$\overline{\text{OSC1}}$	Output	Oscillator 1. When the MSM6679AL-110 uses a crystal oscillator, this output is the oscillator output pin. The pin is then connected to one side of a crystal and load capacitor. When used with an external clock, this output is left unconnected.
41	V_{DD}	Digital Power	Power.
42	NC	(do not connect)	Reserved. These pins are reserved for future use and must be left open.
43			
44			
45			
46	$\overline{\text{SLEEP}}$	Output	Sleep. When power down mode, this pin becomes low. Sleep signal can be used for external memory control.

Pin #	Pin Name	Signal Type	Description
47	NC	(do not connect)	Reserved. These pins are reserved for future use and must be left open.
48			
49	$\overline{\text{RDRAM}}$	Output	RAM Read. This is a strobe signal for direct connection to an external RAM's $\overline{\text{RD}}$ input. When asserted LOW, this signal indicates that the MSM6679AL-110 is ready to read data from RAM.
50	$\overline{\text{WRRAM}}$	Output	RAM Write. This is a strobe signal for direct connection to an external RAM's $\overline{\text{WR}}$ input. When asserted LOW, this signal indicates that the MSM6679AL-110 is ready to write data to RAM.
51	D0	Bidirectional I/O	Memory Data Bus.
52	D1		
53	D2		
54	D3		
55	D4		
56	D5		
57	D6		
58	D7		
59	GND	Digital Ground	Ground.
60	A0	Output	Memory Address Bus.
61	A1		
62	A2		
63	A3		
64	A4		
65	A5		
66	A6		
67	A7		
68	A8		
69	A9		
70	A10		
71	A11		
72	A12		
73	A13		
74	A14		
75	A15		

Pin #	Pin Name	Signal Type	Description
76	NC	(do not connect)	Reserved. These pins are reserved for future use and must be left open.
77			
78			
79			
80	V_{DD}	Digital Power	Power.
81	VREF	Analog Power Reference Voltage	Analog Power. The MSM6679AL-110's on-chip A/D converter uses this analog power when converting an analog signal into digital samples. Also this is used as an analog reference voltage.
82	ADC0	Analog Input	Analog Input. These eight inputs are tied together and serve as the analog input. Signal conditioning, via a bandpass fillter and gain circuit, is required before this input.
83	ADC1		
84	ADC2		
85	ADC3		
86	ADC4		
87	ADC5		
88	ADC6		
89	ADC7		
90	AGND	Analog Ground	Analog Ground. This pin provides an analog ground point, allowing independent grounding of the analog and digital circuitry. Separate grounds reduce the impact of digital switching noise on analog sampling accuracy.
91	RXD	Input	Serial Port Receive. This is the receive data line for serial port.
92	TXD	Output	Serial Port Transmit. This is the transmit data line for serial port.
93	GND	Ground	Ground.
94	NC	(do not connect)	Reserved. These pins are reserved for future use and must be left open.
95			
96			
97			
98			
99			
100			

ELECTRICAL SPECIFICATIONS

Absolute Maximum Ratings

Parameter	Symbol	Conditions	Value	Unit
Digital power supply voltage	V_{DD}	GND = AGND = 0 V	–0.3 to +7.0	V
Input voltage	V_I		–0.3 to V_{DD} +0.3	
Output voltage	V_O		–0.3 to V_{DD} +0.3	
Analog power/reference voltage	V_{REF}		–0.3 to V_{DD} +0.3	
Analog input voltage	V_{AI}		–0.3 to V_{REF}	
Power dissipation	PD	Ta = 70°C, per package	650	mW
		Ta = 70°C, per output	8	
Storage temperature	T_{STG}	—	–50 to +150°C	°C

1. Permanent device damage may occur if ABSOLUTE MAXIMUM RATINGS are exceeded. Functional operation should be restricted to the conditions as detailed elsewhere in this data sheet. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

Operating Conditions

Parameter	Symbol	Conditions	Value	Unit
Digital power supply voltage	V_{DD}	f_{OSC} = 14.3182 MHz	2.7 to 5.5	V
Analog power/reference voltage	V_{REF}	—	V_{DD} –0.3 to V_{DD}	
Analog input voltage	V_{AI}	—	A_{GND} to V_{REF}	
Storage holding voltage	V_{DDH}	f_{OSC} = 0 MHz	2.0 to 5.5	
Operating frequency	f_{OSC}	V_{DD} = 2.7 to 5.5 V	14.3182	MHz
Ambient temperature	Ta	—	–30 to 70°C	°C
Fan-out	N	MOS load	20	
		TTL load, D0 ~ D7, $\overline{\text{WRRAM}}$, $\overline{\text{RDRAM}}$ and $\overline{\text{SLEEP}}$	6	
		TTL Load, all other outputs	1	

DC Characteristics (VDD = 2.7 to 5.5 V, Ta = -30 to 70˚C)

Parameter	Symbol	Condition	Rated Value			Unit
			Min	Typ [1]	Max	
High-level input voltage	V_{IH}	Applied to D0-D7	0.44 × V_{DD}	—	V_{DD} +0.3	V
		Applied to all other I/O	0.80 × V_{DD}	—	V_{DD} +0.3	
Low-level input voltage	V_{IL}	Applied to D0-D7	–0.3	—	0.16 × V_{DD}	
		Applied to all other I/O	–0.3	—	0.2 × V_{DD}	
High-level output voltage	V_{OH}	Output current = –400 μA, applied to D0-D7, $\overline{\text{WRRAM}}$, $\overline{\text{RDRAM}}$ and $\overline{\text{SLEEP}}$	V_{DD} –0.4	—	—	
		Output current = –200 μA, for all other I/O	V_{DD} –0.4	—	—	
Low-level output voltage	V_{OL}	Output current = 3.2 mA, applied to D0-D7, $\overline{\text{WRRAM}}$, $\overline{\text{RDRAM}}$ and $\overline{\text{SLEEP}}$	—	—	0.5	
		Output current = 1.6 mA, for all other I/O	—	—	0.5	
Input leak current	I_{IH}, I_{IL}	V_I = V_{DD}/0 V, applied to ADC0-ADC7	—	—	1/–1	μA
Input current		V_I = V_{DD}/0 V, applied to $\overline{\text{RES}}$	—	—	1/–250	
		V_I = V_{DD}/0 V, applied to OSC0	—	—	15/–15	
High-level output current	I_{OH}	V_O = 2.4 V, applied to D0-D7	–2	—	—	mA
		V_O = 2.4 V, applied to all other I/O	–1	—	—	
Low-level output current	I_{OL}	V_O = 2.4 V, applied to D0-D7	10	—	—	
		V_O = 2.4 V, applied to all other I/O	5	—	—	
Output leakage current	I_{LO}	V_O = V_{DD}/0 V		—	±10	μA
Input capacitance	C_I	f = 1 MHz, Ta = 25˚C	—	5	—	pF
Output capacitance	C_O		—	7	—	
Analog reference power supply voltage	I_{REF}	During voice input	—	—	4	mA
		When voice input is halted	—	—	10	μA
Power consumption	I_{DD}	f_{OSC} = 14.3182 MHz, no load	—	—	T.B.D	mA

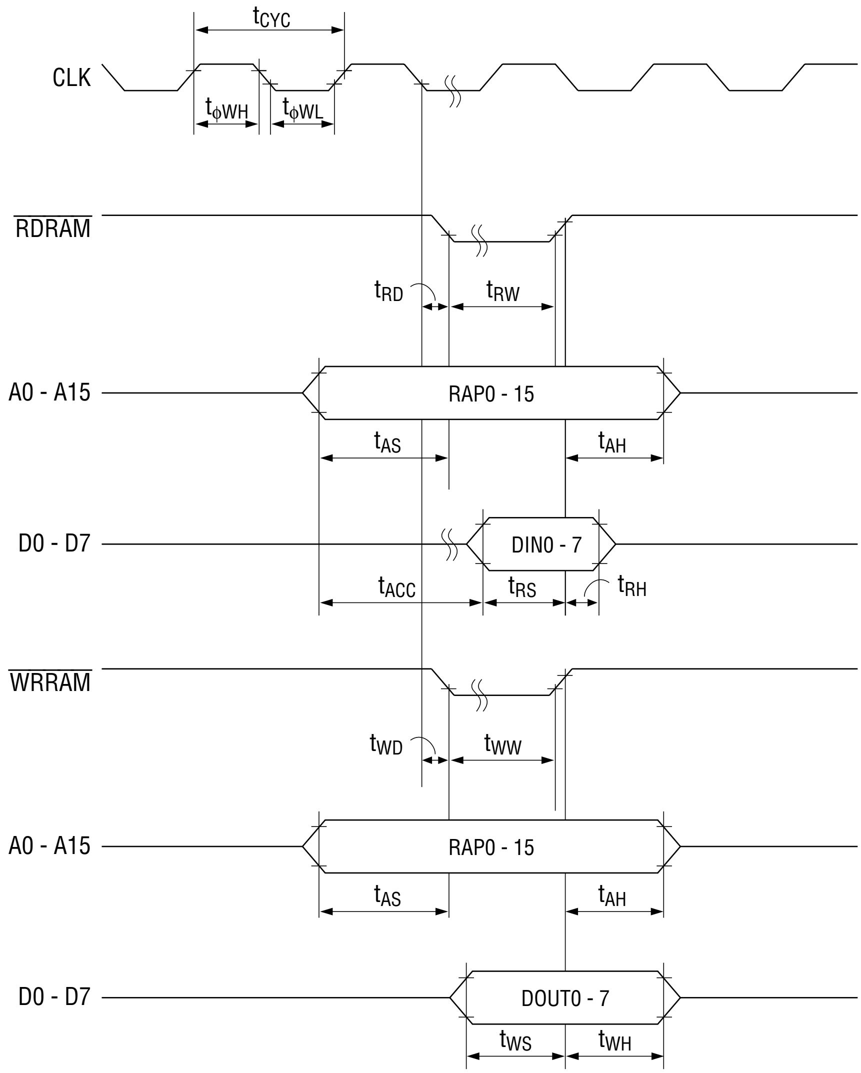
1. Typical condition is 3 V 25˚C.

AC Characteristics

External Data Memory Control (VDD = 2.7 ~ 5.5 V, Ta = -30 ~ 70°C)

Parameter	Symbol	Condition	Min.	Max.	Unit
Cycle time	t_{CYC}	—	69.8	—	ns
Clock pulse width (HIGH level)	$t_{\phi WH}$	C_L = 50 pF	28	—	
Clock pulse width (LOW level)	$t_{\phi WL}$		28	—	
$\overline{\text{RDRAM}}$ pulse width	t_{RW}		190	—	
$\overline{\text{WRRAM}}$ pulse width	t_{WW}		190	—	
$\overline{\text{RDRAM}}$ pulse delay time	t_{RD}		—	75	
$\overline{\text{WRRAM}}$ pulse delay time	t_{WD}		—	75	
Address set-up time	t_{AS}		–5.1	—	
Address hold time	t_{AH}		29	41	
Read data set-up time	t_{RS}		60	—	
Read data hold time	t_{RH}		0	—	
Read data access time	t_{ACC}		—	124	
Write data set-up time	t_{WS}		169	—	
Write data hold time	t_{WH}		29	41	

Timing Diagram


t_{CYC}
CLK
$t_{\phi WH}$
$t_{\phi WL}$
$\overline{\text{RDRAM}}$
t_{RD}
t_{RW}
A0 - A15
RAP0 - 15
t_{AS}
t_{AH}
D0 - D7
DIN0 - 7
t_{ACC}
t_{RS}
t_{RH}
$\overline{\text{WRRAM}}$
t_{WD}
t_{WW}
A0 - A15
RAP0 - 15
t_{AS}
t_{AH}
D0 - D7
DOUT0 - 7
t_{WS}
t_{WH}

CLK : Clock pulse
$\overline{\text{WRRAM}}$: RAM write strobe signal
$\overline{\text{RDRAM}}$: RAM read strobe signal
A0 - A15 : Memory address bus
RAP0 - 15 : RAM address
DIN0 - 7 : Read data
DOUT0 - 7 : Write data

Figure 5. RAM Read/Write Timing

SYSTEM CONFIGURATION EXAMPLE

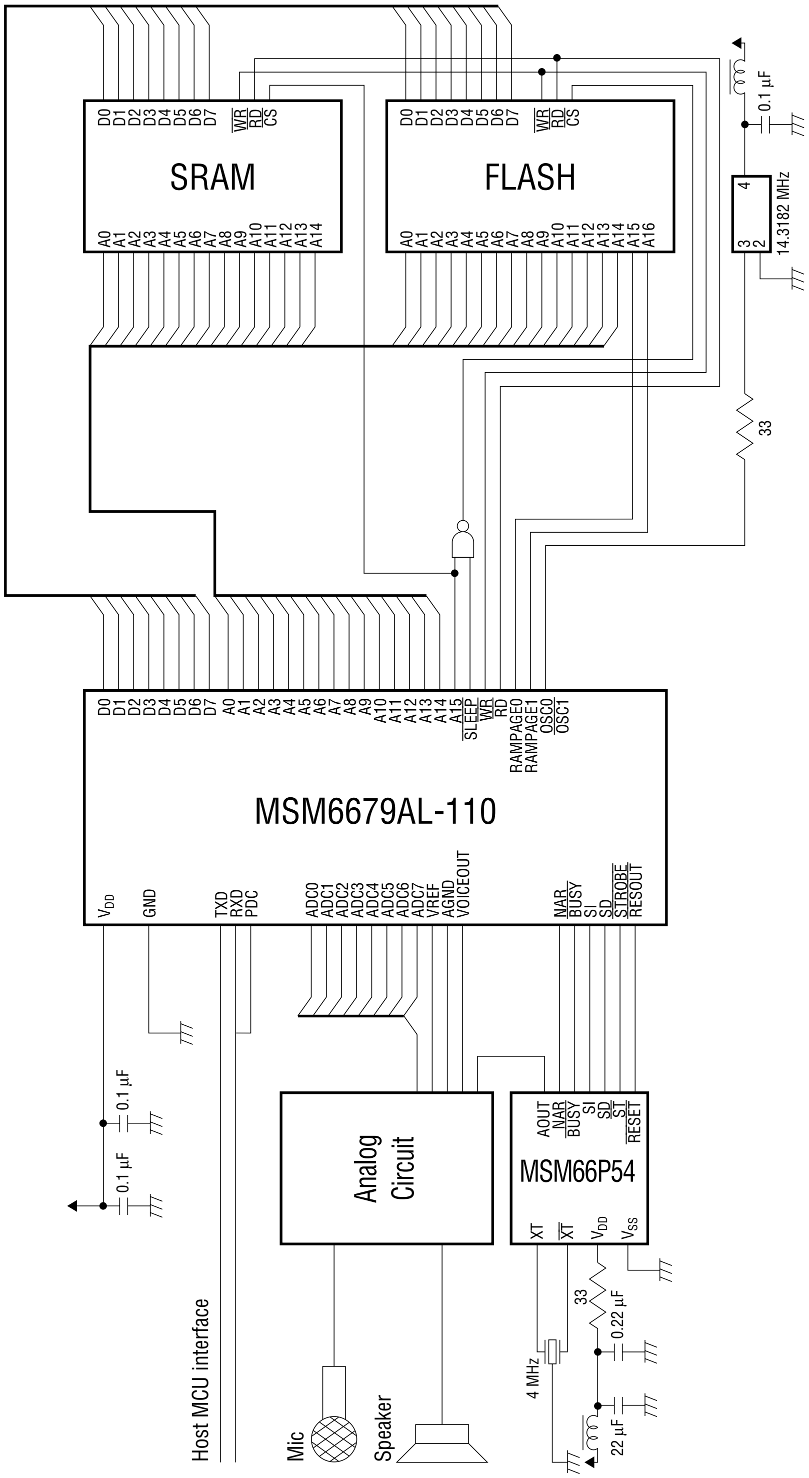

SRAM
D0
D1
D2
D3
D4
D5
D6
D7
WR
RD
CS
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
FLASH
D0
D1
D2
D3
D4
D5
D6
D7
WR
RD
CS
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
A16
0.1 µF
4
3
2
14.3182 MHz
33
MSM6679AL-110
D0
D1
D2
D3
D4
D5
D6
D7
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
A12
A13
A14
A15
SLEEP
WR
RD
RAMPAGE0
RAMPAGE1
OSC0
OSC1
V_{DD}
GND
TXD
RXD
PDC
ADC0
ADC1
ADC2
ADC3
ADC4
ADC5
ADC6
ADC7
VREF
AGND
VOICEOUT
NAR
BUSY
SI
SD
STROBE
RESOUT
0.1 µF
0.1 µF
Host MCU interface
Analog Circuit
Mic
Speaker
MSM66P54
AOUT
NAR
BUSY
SI
SD
ST
RESET
XT
XT
VDD
VSS
33
0.22 µF
4 MHz
22 µF

Figure 6. MSM6679AL-110 System Configuration Example

FUNCTIONAL DESCRIPTION

Voice Recognition

The MSM6679AL-110 performs both SI and SD recognition. SI vocabularies are embedded in the MSM6679AL-110. For SD recognition, each recognized phrase must be enrolled in the MSM6679AL-110's vocabulary by creating a composite template from multiple recordings of the same phrase. Then the composite tempalte is stored in SRAM or FLASH memory. During both SI and SD recognition, the MSM6679AL-110 performs the following steps:

1. After external band-pass filtering, the MSM6679AL-110 converts the analog signal to PCM samples.
2. The MSM6679AL-110 extracts significant features from the sample data by frequency and time-domain analysis.
3. The MSM6679AL-110 compares the analyzed input with the reference data for each signal, weighing the significance of similarities according to control software parameters. A score (expressed as distance) is generated for each phrase.
4. The vocabulary phrase that achieves the highest score (or lowest distance) is judged to match the input phrase, assuming that the score exceeds a predetermined threshold.
5. Via a special command, the MSM6679AL-110 can also return the scores of the input against all defined vocabulary phrases for SI or SD recognition. This feature allows external host software to select the next best match, if the closest match is not contextually logical.

SI Recognition

Oki supplies the MSM6679AL-110 with predefined SI vocabularies which Oki builds from hundreds of utterances by a wide variety of speakers. SI vocabularies are limited to 25 words or less, which allows the MSM6679AL-110 to achieve a net accuracy of >95%, even in noisy conditions.

SI vocabularies are grouped into sub-vocabularies of ≤15 words, to maintain the highest accuracy. Similar words in any one sub-vocabulary can cause substitution errors.

Oki Semiconductor's standard cellular vocabulary is intended for an automotive environment with a far-talk microphone. This vocabulary may work adequately in other conditions, such as an office or outside, but recognition performance may be degraded.

MSM6679AL-110 Cellular SI Recognition Vocabulary

Sub-Vocabulary 1		Sub-Vocabulary 2				Sub-Vocabulary 3	
Phrase	**Index**	**Phrase**	**Index**	**Phrase**	**Index**	**Phrase**	**Index**
Store	1	One	1	Eight	8	Yes	1
Dial	2	Two	2	Nine	9	No	2
Delete	3	Three	3	Zero	Ah	Cancel	3
Directory	4	Four	4	Oh	Bh	—	—
—	—	Five	5	Stop	Ch	—	—
—	—	Six	6	Clear	Dh	—	—
—	—	Seven	7	—	—	—	—

MSM6679AL-110 Control Vocabulary

Sub-Vocabulary 1		Sub-Vocabulary 2	
Phrase	**Index**	**Phrase**	**Index**
A/C	1	Low	1
Fan	2	Medium	2
Temperature	3	High	3
Timer	4	Increase	4
Service	5	Decresse	5
Help	6	Set	6
Select	7	Reset	7
—	—	Cancel	8
—	—	Clear	9
—	—	Recall	A
—	—	On	B
—	—	Help	C

MSM6679AL-110 Direction Vocabulary

Sub-Vocabulary 1	
Phrase	**Index**
Up	1
Down	2
Left	3
Right	4
Formard	5
Reverse	6
Faster	7
Slower	8
Start	9
Stop	A
Cancel	B

MSM6679AL-110 Browse Vocabulary

Sub-Vocabulary 1						Sub-Vocabulary 2			
Phrase	**Index**	**Phrase**	**Index**	**Phrase**	**Index**	**Phrase**	**Index**	**Phrase**	**Index**
Up	1	Next	5	Home	9	Set	1	On	5
Down	2	Previous	6	—	—	Reset	2	Play	6
Left	3	Select	7	—	—	Start	3	Lock	7
Right	4	Cancel	8	—	—	Stop	4	Cancel	8

MSM6679AL-110 Japanese Navigation Vocabulary

Sub-Vocabulary 1		Sub-Vocabulary 2		Sub-Vocabulary 3		Sub-Vocabulary 4	
Phrase	**Index**	**Phrase**	**Index**	**Phrase**	**Index**	**Phrase**	**Index**
Genzaichi	1	Ue	1	Hyoujun	1	Hai	1
Jiaku	2	Shita	2	Kakudai	2	Iie	2
Kaisya	3	Hidari	3	Shukushou	3	Ofu	3
Houi	4	Migi	4	Zentai	4	—	—
Sentaku	5	—	—	Kaiten	5	—	—
Yuudou	6	—	—	Kyori	6	—	—
Nabi	7	—	—	Hosei	7	—	—
—	—	—	—	Teisei	8	—	—

MSM6679AL-110 Japanese Cellular Vocabulary

Sub-Vocabulary 1		Sub-Vocabulary 2			
Phrase	**Index**	**Phrase**	**Index**	**Phrase**	**Index**
On	1	Ichi	1	Kyuu	9
Ofu	2	Ni	2	Zero	A
Daiyaru	3	San	3	Sharp	B
Tansyuku	4	Yon	4	Star	C
Denwacho	5	Go	5	Kakunin	D
Kakunin	6	Roku	6	Touroku	E
Nabi	7	Nana	7	Rei	F
—	—	Hachi	8	—	—

MSM6679AL-110 German Cellular Vocabulary

Sub-Vocabulary 1		Sub-Vocabulary 2				Sub-Vocabulary 3	
Phrase	**Index**	**Phrase**	**Index**	**Phrase**	**Index**	**Phrase**	**Index**
Speichern	1	Eins	1	Neun	9	Ja	1
Wählen	2	Zwei	2	Null	A	Nein	2
Löschen	3	Drei	3	Notruf	B	Löschen	3
Name	4	Vier	4	Wählen	C		
		Fünf	5	Löschen	D		
		Sechs	6	Raute	E		
		Sieben	7	Stern	F		
		Acht	8				

SI vocabulary generation starts with collecting reference utterances from ≥400 speakers with:

- An equal mixture of males and females
- Accents from all regions of the country of intended use
- ~15% non-native speakers.

The samples should be generated from a randomly-ordered list, with each word spoken twice and with a dummy word at the beginning and end. There must be >2 sec between each sample for accurate data processing. To provide the audio fidelity required for high-quality recognition training, a DAT recorder, together with the microphone that will be used in the final application, is required. To ensure data integrity, data is submitted to Oki after collecting samples from the first 20 speakers for initial screening. If acceptable, then the remaining collection may proceed. If substitution errors are possible, collection of spare words during initial collection is recommended. For example, alternate words to "Stop" and "Top" could be "Halt" and "First." Collections should contain a wide variety of the background sound conditions that will exist during actual usage. For example, if the collection is for use in an automobile, conditions such as vehicle speed, road conditions, various window opening positions, heater or AC blower speeds and radio volumes should be varied during the collection. The signal-to-noise ratio should be maintained at ≥ 20dB.

To achieve high accuracy rates, phrase selection, data collection, background initialization strategy, and control software need careful consideration. There are no published standards for recognition accuracy.

Oki defines accuracy by:

$$\text{Accuracy} = 100\% - E_{RATE}$$
$$E_{RATE} = E_{SUB} + 1/2\, E_{REJ}$$

with the following definitions:

Parameters for Recognition Accuracy

Name	Symbol	Condition
Substitution Error	E_{SUB}	Most critical type error, e.g., Say "Five", recogrize "Nine"
Rejection Error	E_{REJ}	Word not recognized, opportunity for operator to repeat
Gap Error	E_{GAP}	Word spoken before recognizer ready
Time-Out Error	E_{TME}	Word length is too long
Spurious Response Error	E_{SPU}	Sourd or imvalid word classfied as a valid word (i.e., drop handset or speak wong word)

A typical target accuracy of 97% is achieved with a 3% E_{RATE}, composed of a 1.5% E_{SUB} rate and a 3%E_{REJ} rate.

SD Recognition

In SD recognition mode, the MSM6679AL-110 can be trained to recognize up to 61 words. The MSM6679AL-110 can support multiple speakers by switching vocabularies, but only one speaker's vocabulary should be active at one time.

The end user enrolls a phrase in the MSM6679AL-110's vocabulary by recording the phrase three times or more. The host Micro Controller Unit (MCU) controls the number of times each phrase in enrolled. Generally, higher recognition accuracy is achieved with each additional enrollment. The word set is made more robust by pronouncing each phrase slightly differently during initial enrollment.

In addition to enrollment training, adaptive template updating can drive the accuracy towards 100%. The host MCU updates templates by first asking the speaker to confirm a recognized phrase with a "yes" or "no" response, and subsequently updating the template for corresponding words. The use of name tags (see next paragraph) facilitates this process.

Name Tag Recording

To facilitate SD recognition, the MSM6679AL-110 supports recording and playback of name tags. Name tags are used to confirm correct responses in SD recognition. For example, in a phone dialer application, the user associates a “name” (which is recorded into memory) with a phone number. The MSM6679AL-110 then plays back the name tag so that the user can verify that the recognized phrase is the correct one.
The VRP stores names tags in memory using an ADPCM compression algorithm with 28 kbps of speech. The length of a name tag is controlled with a command from the users host MCU program. The maximum number of name tags possible is 61, but the actual number is dependent upon record time and memory available. See the section on memory interface for more detail.

Audio Input Interface

A critical item for high-accuracy speech recognition is correct design of the audio input circuit. A circuit with appropriate gain and frequency responses must be placed between the microphone and MSM6679AL-110’s A/D input. Oki recommends input gain and a band pass filter with the following characteristics:

- Four pole Chebyshev high-pass filter, 3 dB point at 225 Hz
- Dual-pole low-pass filter, 3 dB point at 4250 Hz
- Midband gain of 46 dB at 1000 Hz

The above gain and filter characteristics are obtained by using a rail-to-rail quad CMOS op-amp and one-half supply rail splitter to bias the input signal at 1/2 V_{DD} nominal.
The MSM6679AL-110 uses multiple analog inputs to improve sampling quality. An on-chip analogy to digital (A/D) conversion unit transforms the analog signal to a digital data stream.

Audio Output Interface

The MSM6679AL-110 also provides the VOICEOUT1 PWM output. The MSM6679AL-110 uses ADPCM to generate voice or sound-effect output. ADPCM represents an improvement over conventional PCM techniques in that it adaptively changes the quantizer step (scale factor) to suit the waveform being encoded. The result is more efficient memory usage with no loss of quality. Careful selection of the components for internal and external output filters and amplifiers is recommended. An incorrect choice would impair the original quality. This consideration equally includes:

- Careful separation of analog and digital lines
- Grounding of analog lines at both ends
- Further adequate separation from high-speed digital circuits to avoid distortions thereof

Memory Interface

The memory control section manages RAM and/or ROM devices in two 64-Kbyte memory spaces, in conjunction with internal memory for voice templates and working memory. Some versions work with no external memory, some have some external RAM, some use only external EPROM, and some use external memory in conjunction with both internal ROM and RAM. The MSM6679AL-110 requires a minimum of 32 Kbytes SRAM and 16 Kbytes ROM.
The following table shows vocabulary sizes and playback facilities for various configurations.

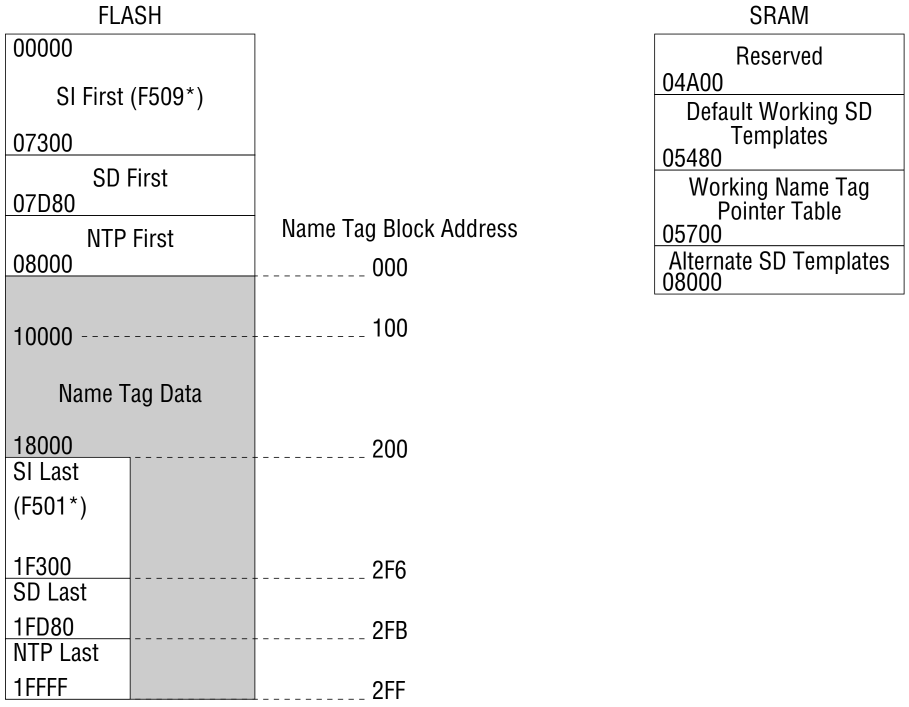
Typical Configurations

Application	Recognition Vocabulary (Words)		MSM6679AL-110 Sound Playback (sec) [1]		MSM665x Playback Interface	MSM6679AL-110 Speech Record	MSM6679AL-110 Speech Playback	Memory Size (bytes)		
	SI	SD	Internal	External				EPROM	Flash	SRAM
Controller	25	61[2]	2.3	9.2	OK	—	OK	64K	—	32K
	50	61[2]	2.3	—	OK	—	OK			
Telephone Dialer	25	61	2.3	27.6	OK	OK	OK	—	128K	32K
	50	61	2.3	18.4	OK	OK	OK			
	75	61	2.3	—	OK	OK	OK			
	100	61	2.3	—	OK	OK	OK			
Computer Peripheral	61[3]	61	2.3	36.8	OK	—	OK	—	—	64-384K
Minimum Configuration	12	61[2]	1.15		OK	—	—	16K	—	32K

1. Phrase chaining features usually permit much longer overall playback durations; not including external speech synthesizer.
2. SD recognition vocabularies are volatile in these configurations.
3. Per download. Vocabulary swapping by host permits unlimited vocabulary size.

The MSM6679AL-110 supports 32 Kbytes of RAM, and up to 64 Kbytes of ROM (EPROM or Flash) per bank in separate memory spaces.

For accessing the ROM and RAM address spaces, the MSM6679AL-110 provides the separate Write RAM ($\overline{\text{WRRAM}}$) and Read RAM ($\overline{\text{RDRAM}}$) signals. The $\overline{\text{RDRAM}}$ signals connect directly to Output Enable ($\overline{\text{OE}}$) control signal inputs on the RAM and ROM, respectively. The $\overline{\text{WRRAM}}$ signal connects directly to the Write Enable ($\overline{\text{WE}}$) control signal input on the RAM.


FLASH
00000
SI First (F509*)
07300
SD First
07D80
NTP First
08000
10000
Name Tag Data
18000
SI Last
(F501*)
1F300
SD Last
1FD80
NTP Last
1FFFF
Name Tag Block Address
000
100
200
2F6
2FB
2FF
SRAM
Reserved
04A00
Default Working SD Templates
05480
Working Name Tag Pointer Table
05700
Alternate SD Templates
08000

*Denotes commands to select blocks

Figure 7. MSM6679AL-110 External Memory Map

External Voice Synthesis Control

The MSM6679AL-110 is capable of interfacing to the MSM665x family of Oki ROM, OTP, or external EPROM speech synthesizers, allowing for up to 260 seconds of high-quality voice and sound effects. The following table indicates the speech capabilities of the MSM665x family.

MSM665x Family Characteristics

Type	Data ROM Capacity[1]	Maximum Speech Duration[2]				
		f_{SAM} = 4.0 kHz	f_{SAM} = 6.4 kHz	f_{SAM} = 8.0 kHz	f_{SAM} = 16.0 kHz	f_{SAM} = 32.0 kHz
MSM6650	64 Mbits[3]	>1 hour	>40 minutes	>30 minutes	>15 minutes	>8 minutes
MSM6652	288 Kbit	16.9 sec	10.5 sec	8.4 sec	4.2 sec	2.1 sec
MSM6653	544 Kbit	31.2 sec	19.5 sec	15.6 sec	7.8 sec	3.9 sec
MSM66P54[4]	1 Mbit	63.8 sec	39.9 sec	31.9 sec	15.9 sec	7.9 sec
MSM6654	1 Mbit	63.8 sec	39.9 sec	31.9 sec	15.9 sec	7.9 sec
MSM6655	1.5 Mbit	96.5 sec	60.3 sec	48.2 sec	24.1 sec	12.0 sec
MSM66P56[5]	2 Mbit	129.1 sec	80.7 sec	64.5 sec	32.2 sec	16.1 sec
MSM6656	2 Mbit	129.1 sec	80.7 sec	64.5 sec	32.2 sec	16.1 sec
MSM6658	4 Mbit	258 sec	161.4 sec	129.1 sec	64.5 sec	32.2 sec

1. Actual ROM area in MSM6652, MSM6653, MSM6654, MSM6655, and MSM6656, MSM6658, MSM66P54, MSM66P56 is smaller by 22 Kbits.

2. Longer speech patterns can be created by chaining and repeating existing speech samples.
3. Via external ROM only (no on-chip ROM available).
4. One-Time-Programmable (OTP) version of MSM6654. See the MSM66P54 data sheet for more information.
5. One-Time-Programmable (OTP) version of MSM6656. See the MSM66P56 data sheet for more information.

The MSM665x interface consists of the following signals:
- $\overline{\text{BUSY}}$ - Asserted LOW during MSM665x device playback. The MSM6679AL-110 F50Bh and F10100xxh commands select this signal for MSM665x command polling.
- $\overline{\text{NAR}}$ - Next Address Request status signal. By default, the MSM6679AL-110 uses this signal to poll commands to the MSM665x. The F51Bh, F480h, and F440h commands select NAR for polling.
- SI - Serial Input Clock.
- SD - Serial Data Out.
- $\overline{\text{STROBE}}$ - Initiates speech synthesis.
- $\overline{\text{RESOUT}}$ - Initializes device when asserted LOW. The MSM6679AL-110 F480h command generates this signal.

Serial Interface

The MSM6679AL-110 supplies a serial interface suitable for connection to an RS-232C serial port buffer or equivalent. The serial interface uses one MSM6679AL-110 input (RXD) and one MSM6679AL-110 output (TXD). The interface operates at 9600 Baud with:
- 8 data bits
- 1 start bit
- 1 stop bit
- No parity
- No handshake

A host processor sends serial ASCII commands to the MSM6679AL-110 and receives serial ASCII responses based on voice input responses.

MSM6679AL-110 SLAVE-MODE API

This section describes the slave-mode Applications Protocol Interface (API) between a host MCU and the MSM6679AL-110. The slave-mode API offers the following features:

- Direct slave-mode control voice recognition, sound recording and playback, and sound synthesis
- Serial port interfaces
- Simple procedures for downloading and uploading data
- ASCII format
- Comprehensive return codes and error reporting

The host MCU selects the active speech recognition vocabulary, speech responses, and controls all actions required to implement an interactive voice response system. The MSM6679AL-110 performs speech recognition, based on the vocabulary selected by the host, and returns digital codes representing the most probable match of the current utterance to an individual utterance in the selected vocabulary. The MSM6679AL-110 can also respond with “name tags.” Name tags can be fixed words, phrases or sound effects, or can be words, phrases or sound effects that have been interactively recorded by the user.

The API supports serial interface. The MSM6679AL-110 returns each response using the same interface through which the most recent message was received. The user can thus connect and use both interfaces.

For all messages, the serial interface represents each 8-bit value with two hexadecimal digits coded in ASCII. When downloading and uploading data, the MSM6679AL-110 uses a stream of 8-bit binary values.

The serial-mode interface uses a 9600-baud UART with 1 start bit, 8 data bits, and 1 stop bit. There is no parity or handshaking. Serial-interface messages are of variable length, but consist of an even number of bytes. The serial interface echoes all received ASCII characters immediately back to the host MCU.

Messages are of variable length. All messages consist of an even number of bytes. Opcodes consist of exactly four bytes, with values between F000h and FEFEh. Operand bytes may take values from 0000h to FFFFh. The MSM6679AL-110 issues a return code for many of the host commands. The return code generally consists of the same opcode, followed by data indicating success of failure of the operation.

Opcodes are organized into the following categories:

- Purge
- Set parameter
- Initialize
- Recognize
- Speak
- Request
- Record
- SD recognition control

The following tables summarize available opcodes and provide detailed descriptions of the opcode functions.

Command Summary

Function	Opcode (Hex)	Description	Default (Hex)
Purge	F000	Clear MSM6679AL-110 input stack	—
Set parameter	F102 xxxx F103 xxxx F104 xxxx F12x F130 xxxx	Set SP/SI origin to xxxx. Set SD origin. Set triggering origin. Set SD SP table to table x. Select triggering table.	8000 4A00 F100 F123 0101, 0202...
Initialize	F2xx mod 80 F2xx mod 40 F2xx mod 20 F2xx mod 10 F2xx mod 8 F2xx mod 4 F2xx mod 2 F2xx mod 1	Initialize background estimation. Wait for F3h command after each response. Beep after each triggered utterance Reserved Set speech response level to default. Send acknowledge after each speech output response. Only detect triggers. Initialize SD parameter table and name tags.	Disabled. Disabled. Disabled. Disabled. Enabled. Enabled. Disabled. Load from first FLASH.
Recognize	F300 F301 to F33F F340 F341 F342 F343 F344 F351 F361 F371	Stop listening (recognition). Start SI recognition. Start SD recognition. Sort SD recognition distances, return index to utterance with least distance. Update SD enrollment. Request recognition parameter upload to host. Sort SD recognition distances, return index and distance to utterance with least distance Sort SD recognition distances, return all distances. Sort SD recognition distances, return minimum and maximum energy values. Sort SD recognition distances, return all energy values and distances.	— — — — — — — — — —
Speak	F401 to F43D F441 to F47C F47E F47F F480 F481 - F4FF F50B F51B FE03 to FEFE	Play back name tag from external memory. Play back sound from internal memory. Play 50-ms beep. Pause for 0.2 sec. Initialize MSM665x IC, set MSM665x busy mode OFF, select FLASH SI recognition. Play back one of 127 phrases in external MSM665x device. Set MSM665x busy mode ON. Set 6654 NAR mode Set output volume (03h = minimum, FEh = maximum).	— — — — — — OFF ON FE80h
Request	F500 F501 F510 F520	Status request. Select last FLASH bank for SI recognition. Select download RAM bank for speaker independent/signal processing (SI/SP) template area. Set MSM6679AL-110 power down mode.	— F509 F509 —

Function	Opcode (Hex)	Description	Default (Hex)
Request	F502....	Download/upload.	—
	F504	Retrieve MSM6679AL-110 firmware revision.	414C
	F505	Initialize background (BG) noise level.	—
	F506	Retrieve vocabulary and trigger table revision number.	3039
	F507	Save SD templates from download RAM to first FLASH.	—
	F517	Save SDR templates in last FLASH. (4A00-547B→F300-FD7F)	—
	F508	Recall SD templates from first FLASH to download RAM.	—
	F518	Get SDR Templates from last FLASH (F300-FD7B→4A00-547B)	—
	F509	Select first FLASH bank for SI recognition.	F509
Record	F101 00xx	Set name tag length, set MSM665x busy mode ON.	0051
	F105	Set name tag record origin	0000
	F106	Set name tag record end	01FF
	F50A	Clear name tag table in SRAM (5480 - 56FF).	—
	F50C	Recall last saved name tag table.	—
	F51C	Recall name tag pointers from last FLASH (FD80-FFFF→5480-56FF)	—
	F50D	Save name tag table from SRAM to FLASH.	—
	F51D	Save name tag pointers in last FLASH (5480-56FF→FD80-FFFF)	—
	F50E	Set record volume high.	F50F
	F50F	Set record volume normal (default).	F50F
	FA01 ~ FA3D	Record name tag 01h - 3Dh.	—
SD Recognition Control	F6xx	Set SD pointer to segment xxh.	—
	F9xx	Search for SD utterance xxh.	—
	FB00	Enroll SD utterance selected by search command (F9xx).	—
	FC00	Erase utterance from SD vocabulary.	—
	F521	Clear SDR table (4A00 - 547B)	—

Response Summary

Command	Operands	Description
Result after Parameter Set	F101h 00 tm	Record time = tm*14 msec.
	F102h AdH AdL	High and low bytes of SP/SI origin address.
	F103h AdH AdL	High and low bytes of SD origin address.
	F104h AdH AdL	High and low bytes of triggering origin address.
	F12Xh	SP table Xh selected.
Initialization Acknowledgment	F280h	Invalid message received.
	F240h	Sample data over-run. [1]
	F220h	32-Kbyte block boundary violation error.
	F210h	Unclassified download/upload error.
	F208h	Divide-by-zero error.
	F204h	Select/jump error.
	F202h	Invalid SP header or table.
	F201h	Reserved.
Speech Ack	F400h	Speech acknowledgment. [2]

Response Summary (Continued)

Command	Operands	Description
Status [3]	F500h	MSM6679AL-110 ready.
	F501h	Operation complete.
	F520h	Operations complete; MSM6679AL-110 disabled (vocabulary 0).
	F540h	MSM6679AL-110 waiting for start command.
	F560h	MSM6679AL-110 waiting for end trigger.
	F580h	MSM6679AL-110 processing recognition.
	F5A0h	Download/upload in progress. [4]
	F5C0h	Download/upload complete.
	F5F0h	Speak output in progress.
SI Recognition Result [5]	F600h	Aborting SI listen mode.
	F6Utt	Utt = utterance ID.
	F6 Utt Dst1H Dst1L...DstNH DstNL	Utterance ID, high/low byte of distance to utterance 1...utterance N.
	F6 Utt EminH EminL EmaxH EmaxL	Utterance ID, high/low byte of min. and max. energy value,
	F6 Utt Dst1H Dst1L...DstNH DstNL EminH EminL EmaxH EmaxL	Utterance ID, high/low byte of distance to utterance 1...utterance N, high/low byte of minimum energy value, high/low byte of maximum energy value.
	F63Ah	Trigger detection code (see init command).
	F63Bh	Rejection: utterance too loud.
	F63Ch	Rejection: utterance too long.
	F63Dh	Rejection: utterance begins too soon.
	F63Eh	Rejection: bad signal/noise ratio.
	F63Fh	Rejection: reason uncertain.
SD Recognition Result	F700h	Aborting SD Listen mode. After SD utterance search: not found.
	F73Eh	Rejection.
	F73Fh	Sort completed. After SD utterance search: empty.
	F740h	Rejection: MSM6679AL-110 SD memory full/empty. After SD utterance search: in use.
	F341h F7Utt	Utt = Utterance ID triggered.
	F344h F7Utt DstH DstL	Utterance ID, high/low byte of distance.
	F351h F7Utt Dst1H Dst1L... DstNH DstNL	Utterance ID, high/low byte of distance to utterance 1... utterance N.
	F361h F7Utt EminH EminL EmaxH EmaxL	Utterance ID, high/low byte of minimum energy value, maximum energy value.
	F371h F7Utt Dst1H Dst1L... DstNH DstNL EminH EminL EmaxH EmaxL	Utterance ID, high and low byte of distance to utterance 1... distance to utterance N, high and low byte of minimum energy value, maximum energy value.
Vector Upload	F743h 0000h	Upload failure.
	F743h NH NL V1H V1L...VNH VNL	High/low bytes of length of vector, V, high/low byte of first V...Nth V.
Trap Error Codes	F801h	Reserved.
	F802h	Invalid SP header or table.
	F804h	Select/jump error.
	F808h	Divide-by-zero error.
	F810h	Unclassified download/upload error.
	F820h	Memory full; 32-Kbyte block boundary violation error.
	F840h	Sample data over-run. [1]
	F880h	Invalid message received.
Record Response	FA00	Record complete.

1. Sample data overrun issued when real-time SP in Listen mode cannot keep up with incoming samples, i.e., if the A/D signal input routine overwrites a sample data buffer before it is fully processed.
2. This acknowledge is sent only if Init command 1111 0010 xxxx x1xx (F2 xxxx x1xx) is set to enable acknowledgments.
3. These messages are sent in response to a request command (F5XYh) from the host.
4. Upload/download in progress, acknowledging load request immediately before data transfer. If in response to an N-byte download request, the MSM6679AL-110 then receives N bytes (if N is even, or N+1 if N is odd) of data from the host. If N is odd and N+1 bytes are received, only N bytes are written to MSM6679AL-110 memory. If in response to an upload, the MSM6679AL-110 then sends N bytes (if N is even, or N+1 if N is odd) of data to the host.
5. If an utterance was recognized, XYh is the utterance identity or class number, and additional parameters may be appended, if requested in the SI Recog (F3XYh with X=0...3) command. Otherwise, XYh indicates various results as detailed.

Command Descriptions

Purge

Operand	Description	Return Values
F000	Purge MSM6679AL-110 Input Stack. This command clears the MSM6679AL-110 input stack of commands that are waiting to be executed. Commands already in progress, such as a pending MSM6654 poll action, are not affected. It does not affect the MSM6679AL-110 output stack.	None

Set Parameter

Operand	Description	Return Values [1]
F102h XXYYh	Set SP/SI Recognition Origin. Prior to SD or SI recognition, address pointers must be set to point at the SP or SI recognition parameter tables.This command sets the starting address of SP and SI recognition parameter tables. This address is the location of the first word of a header that contains pointers to one or more individual SP/SI tables. XXYYh = high (XXh) and low (YYh) bytes of requested address. The MSM6679AL-110 uses and returns an even address outside the MSM6679AL-110 work space that is as near as possible to the requested address. Leave this parameter at its default value unless you are using an Oki custom SI vocabulary and are instructed to alter SP/SI recognition origin. Default SP/SI origin: 8000h	F102h XXYYh = High (XXh) and low (YYh) bytes of resultant address. If a valid header is not found at the resultant address, the MSM6679AL-110 immediately sends response code: F802h = Invalid SP/SI header.
F103h XXYYh	Set SD Recognition Origin [2]. This command sets the SD origin address at the starting address of the current SD recognition parameter table. This command may be used to select among mul-tiple RAM-resident SD vocabulary tables. XXYYh = high (XXh) and low (YYh) bytes of requested address. The MSM6679AL-110 uses and returns an even address outside the MSM6679AL-110 work space that is as near as possible to the requested address. Leave this parameter at its default value unless you are using an Oki custom vocabulary and are instructed to alter SD recognition origin. The table length is 0A7Ch bytes. Default SD origin: 4A00h	F103h XXYYh = high (XXh) and low (YYh) of resultant address.
F104h XXYYh	Set Triggering Origin. This command sets the starting address of triggering parameter tables. This address is the location of the first word of a section of data memory containing one or more contiguous triggering parameter tables. XXYYh = high (XXh) and low (YYh) bytes of requested address. The MSM6679AL-110 uses and returns an even address outside the MSM6679AL-110 work space that is as near as possible to the requested address. Leave this parameter at its default value unless you are using an Oki custom SI vocabulary and are instructed to alter triggering origin. Default triggering origin: F100h	F104h XXYYh = high (XXh) and low (YYh) bytes of resultant address.

Set Parameter (Continued)

Operand	Description	Return Values [1]
F12Yh	Set SD Recognition SP table. This command sets the SP parameter table number to be used in processing speech input during SD Recognition. The MSM6679AL-110 selects SP table number Z, where Z is the nearest valid value to Y. By default, the MSM6679AL-110 selects SP table 3 until this command is issued. This command selects SP parameters only, and does not select among multiple RAM-resident SD vocabulary tables, which can be independently selected by the Set SD Origin command (F103h). After setting the table number and returning the resultant value, the MSM6679AL-110 checks the validity of the SP header. If the header is invalid, an error message is returned. Set this value to (NSI +1), where NSI is the number of SI subvocabularies. Default SP table: 3.	F12Z = SP table Z selected. If the SP header is invalid, a second message follows: F802h = Invalid SP header.
F130h VN TN	Select Triggering Table. This command selects triggering table TN for use with SP table VN. Valid values for VN and TN are between 01h and 0Fh. Leave this parameter at its default value unless you are using an Oki custom SI vocabulary and are instructed to alter the triggering table.	F130h f(VN) f(TN) = Triggering table selected. Default = 0101, 0202, 0303...

1. Return value is actual parameter value which may not equal the set parameter value.
2. See also F6XY

Initialize

F2xx Bit Values	Power-On/ Reset Value	Action	Return Value
After power-on, the MSM6679AL-110's mode corresponds to that after issuing a F20C command. This mode may NOT be the optimum condition for most situations, so the user is advised to carefully understand the desired condition and develop a suitable command for the application at hand. In addition, ensure that unwanted bits do not get set or reset when attempting to set individual conditions. The conditions selected are based on the XXh values associated with the last F2 command issued.			
1xxx xxxx	Cleared	Background Noise Initialization. When set to 1, the MSM6679AL-110 starts a 500-ms background noise initialization. When set to 0, the MSM6679AL-110 does not perform background noise initialization. The MSM6679AL-110 requires this command prior to recognition for noise vector subtraction during the utterance sampling period. Use the background initialization command whenever there is a change in the background noise level. For example, sample the noise signature in a vehicle at rest and moving at 35 MPH with its windows rolled down. The quality of a phone line connection can also vary from call to call. The host MCU must implement a strategy as to when to issue a background initialization command. In a vehicle, the host MCU could monitor the vehicle speed, fan speed, radio volume, etc. Alternatively, the host MCU could issue this command each time a new recognition session starts or a new line connection is established. However, the 0.5-sec sample period could degrade system responsiveness if used too frequently. A zero in this bit location during the F2XXh command will not cause an initialization. The F505h command causes the same initialization sequence.	F501 = Background initialization complete F2XY = Initialization acknowledge. [1]
x1xx xxxx	Cleared	Wait for Recognition Command/Auto Restart SI Recognition. When set to 1, the MSM6679AL-110 waits for a recognition command after each response. When set to 0, the MSM6679AL-110 auto-restarts SI recogni-tion after each response. This bit should be set to 1 when an action is to be taken immediately after an utterance. Auto-restart recognition is the desired mode during digit string recognition, automated tape testing of digits, or in demonstrations where continuous recognition is desired.	F2XY = Initialization acknowledge. [1]

Initialize (Continued)

F2xx Bit Values	Power-On/ Reset Value	Action	Return Value
xx1x xxxx	Cleared	Beep After Each Voice Trigger. When set to 1, the MSM6679AL-110 beeps after each voice trigger. When set to 0, the MSM6679AL-110 does not beep after each voice trigger. These beeps do not cause a F400h message to be issued to the host MCU. When set to 1, the MSM6679AL-110 beep can help a user avoid speaking before the MSM6679AL-110 is ready. This mode is normally used with a digits vocabulary to pace the user and confirm each utterance reception. Instead of using beeps, an external MSM665x speech synthesizer can repeat digits as they are recognized. However, some users find the number repetition annoying. Therefore, firmware could repeat digits during initial usage and switch to beep mode later. Typically, performance improves with time as users learns to speak with the correct enunciation and volumes. The MSM6679AL-110 in this case trains the user. Note that the host MCU can also make the MSM6679AL-110 beep with the F47Eh command.	F2XY = Initialization acknowledge. [1]
xxxx 1xxx	Set	Set Output Volume. When set to 1, VOICEOUT1 sound output level is set to half of full volume (80h). When set to 0, voice output level is unaffected. MSM6679AL-110 sound output volume can also be set at any level on a continuous scale from 00h to FEh (low to high) with the FEXXh command. The MSM665x speech synthesizer has four discrete sound output volumes, corresponding to 0h - 20h, 21h - 40h, 41h - 80h, and 81h - FEh.	F2XY = Initialization acknowledge. [1]
xxxx x1xx	Set	Send Response Code After Sound Output. When set to 1, the MSM6679AL-110 issues an acknowledge response (F400h) when sound output is completed. When set to 0, the MSM6679AL-110 does not issue an acknowledge response when speech response is completed. Automatic beeps after voice triggers do not cause an F400h command to be issued.	F2XY = Initialization acknowledge. [1]
xxxx xx1x	Cleared	Trigger Detection Only. When set to 1, the MSM6679AL-110 does not sort SI vocabularies for the best match, instead returning F63Ah code when an utterance has been detected. When set to 0, normal recognition is performed. When this bit is set to 1, the host MCU can use the F343h command to upload the recognition parameter vector, so that the host can perform independent processing.	F2XY = Initialization acknowledge. [1]
xxxx xxx1	Cleared	Clear SD Recognition and Name Tag RAM. When set to 1, the MSM6679AL-110 initializes the SD parameter table. When set to 0, existing SD parameters are preserved. After this bit is set to 1, all SD training and name tag pointers are erased. Use this command to start training for a new user. If the old name tags are to be retained, the F50Ch command can recall old name tags from FLASH. To set up for a blank SD and name tag table at the next power-on, issue the command sequence F201h F507h.	F2XY = Initialization acknowledge. [1]

1. See the Response Summary table earlier in this section for a complete description of the XY codes in initialization acknowledgment messages.

Recognize

Opcode	Action		Return Value	
F300h	Stop Listening. This command causes the MSM6679AL-110 to exit SI or SD Listen mode, whichever was active.		None	MSM6679AL-110 was not in Listen mode.
			F600h	Aborting SI Listen mode.
			F700h	Aborting SD Listen mode.
F301h - F33Fh	Start SI Listen Mode. For all the following opcodes, the MSM6679AL-110 per-forms SI recognition on incoming utterances, using SI vocabulary Y. The vocabulary Y is identified by one of 15 sets, thus Y = 1h ~ Fh.		F600h	Aborting SI Listen mode.
			F63Ah	Trigger detection code (see Initialization command).
			F63Bh~F63Fh	Rejection.
			F802h	Invalid signal processing table.
			F840h	Sample data overrun.
	F30Yh	Return recognized phrase using vocabulary number Y.	F6h Utt	Utterance ID in vocabulary Y.
	F31Yh	Return recognized phrase and distance table for vocab Y.	F6h Utt Dst1H Dst1L... DstNH DstNL	Utterance ID in vocabulary Y, high and low byte of distance to utterance 1... distance to utterance N.
	F32Yh	Return recognized phrase and energy value for vocab Y.	F6h Utt EminH EminL EmaxH EmaxL	Utterance ID in vocabulary Y, high and low byte of minimum and maximum energy val-ue.
	F33Yh	Return recognized phrase, distance table, and energy value for vocab Y.	F6h Utt Dst1H Dst1L... DstNH DstNL EminH EminL EmaxH EmaxL	Utterance ID, high and low byte of distance to utterance 1...distance to utterance N, high and low byte of minimum and maximum en-ergy value.
F340h	Start SD Listen Mode. When an utterance is captured, it is analyzed and converted to a "recognition parameter vector." The host may then command the MSM6679AL-110 to use this vector in various ways (e.g., Sort, Update, or Recognition Vector Upload).		F740	Triggered.
			F700	Abort SD Listen mode.
			F73E	Rejection.
			F73F	Memory empty.
			F802	Invalid SP table.
			F840	Sample data overrun.
F341h, F344h, F351h, F361h, F371h	SD Recognition Sort. These commands sort the distances between the recognition parameter vector and the reference vectors for the utterances in the current SD vocabulary.		F73Fh	Abnormal response: Memory empty.
	F341h	Return recognized phrase for vocab Y. This command can be issued several times to yield first, second, third best, etc.	F7h Utt	Utt = Utterance ID.
	F344h	Return recognized phrase and distance for the current vocabulary.	F7h Utt DstH DstL	Utt = index of recognized phrase, DstH DstL = high/low bytes of distance from nearest phrase.
	F351	Return recognized phrase and distance table for vocab Y.	F7h Utt Dst1H Dst1L... DstNH DstNL	Utterance ID, high and low byte of distance to utt. 1...N.
	F361h	Return recognized phrase and energy value for vocab Y.	F7h Utt EminH EminL EmaxH EmaxL	Utterance ID, high and low byte of minimum and maximum energy value.

Recognize (Continued)

Opcode	Action		Return Value	
F341h, F344h, F351h, F361h, F371h	F371h	Return recognized phrase, distance table, and energy value for vocab Y.	F7h Utt Dst1H Dst1L... DstNH DstNL EminH EminL EmaxH EmaxL	Utterance ID, high and low byte of distance to utterance 1...distance to utterance N, high and low byte of minimum and maximum energy value.
F342h	Update SD Recognition Enrollment. This command updates enrollment on utter-ance Utt, immediately after a "F7h Utt" response to the Sort SD Distances command (F341h). Alternatively, the utterance to be updated can be selected by the SD Search command (F9XYh). This command uses the recognition parameter vector from the most recently captured utterance, and does not start SD Listen mode. Generally, update should be performed only if correct utterance identify is confirmed by the user.		F740h	Update complete.
F343h	Recognition Vector Upload. Request recognition parameter vector upload to host.		F743h NH NL V1H V1L... VNH VNL = Success, where NH/NL = high/low bytes of N, N = Length of recognition parameter vector V, V1H/V1L = high/low bytes of first element of V, VNH/VNL = high/low bytes of Nth element.	
			F743h 00 00	Failure.

Speak

Opcode	Action		Return Value	
F401h ~ F43Dh	Speak Phrase from External Memory. This command causes the MSM6679AL-110 to play back a name tag from external memory. If no sound is defined for a selected index, the MSM6679AL-110 plays a beep. See the Record commands for information on creating name tags.		F400h	If enabled, this value is returned upon completion of playback.
F441h ~ F450h	Speak Phrase from Low Internal Memory. If no sound is defined for a selected index, the MSM6679AL-110 plays a beep. The default phrases supplied with the MSM6679AL-110 in the smaller low playback memory area are listed below.		F400h	If enabled, this value is returned upon completion of playback.
	F441h	Drip.		
	F442h	Buzzer.		
	F443h	Dial tone.		
	F444h	Bonk.		

Speak (Continued)

Opcode	Action		Return Value	
F451h ~ F47Ch	Speak Phrase from High Internal/External Memory. If no sound is defined for a selected index, the MSM6679AL-110 plays a beep. The default phras-es supplied with the MSM6679AL-110 in the larger upper playback memory area are listed below.		F400h	If enabled, this value is returned upon completion of playback.
	F451h	"0" simulated DTMF tone.		
	F452h	"1" simulated DTMF tone.		
	F453h	"2" simulated DTMF tone.		
	F454h	"3" simulated DTMF tone.		
	F455h	"4" simulated DTMF tone.		
	F456h	"5" simulated DTMF tone.		
	F457h	"6" simulated DTMF tone.		
	F458h	"7" simulated DTMF tone.		
	F459h	"8" simulated DTMF tone.		
	F45Ah	"9" simulated DTMF tone.		
	F45Bh	"*" simulated DTMF tone.		
	F45Ch	"#" simulated DTMF tone.		
F47D	Reserved. This command is reserved for future use.		—	—
F47Eh	Beep. This causes the MSM6679AL-110 to beep for 50 ms.		F400h	If enabled, this value is returned upon completion of playback.
F47Fh	Pause. This command can be issued while the MSM6679AL-110 is performing sound output and is then put in the MSM6679AL-110 command stack for subsequent processing. When this command is executed, sound output pauses for 0.2 sec. The pause command is useful for word spacing.		F400h	If enabled, this value is returned upon completion of playback.
F480h	Set MSM6654 Mode. This command causes the MSM6679AL-110 to initialize the external MSM665x device, also clearing the device from BUSY mode.		None.	
F481h - F4FFh	Playback Sound from MSM665x Device. This command causes the MSM6679AL-110 to issue a speak command to the MSM665x slave device. The value is passed on the MSM665x device as 01h - 07Fh. The actual phrase is determined by the vocabulary programmed into the MSM665x device. Up to 127 external phrases are supported.		F400h	If enabled, this value is returned upon completion of playback. If NAR is set, the F400h command is sent when the MSM665x device is ready for an-other command. If busy mode is selected, the F400 command is returened when the sound is finished.
F50Bh	Set MSM665x Busy Mode ON.		None.	

Speak (Continued)

<table>
<tr><th>Opcode</th><th colspan="2">Action</th><th>Return Value</th></tr>
<tr><td>F51Bh</td><td colspan="2">Set 6654 NAR mode. This command, which is the complement of the F50B command, sets up the handshaking to the attached 6654 speech synthe-sizer to use the NAR. This setup uses the 6654's double buffer feature to eliminate any gap between two consecutive phases.</td><td>None.</td></tr>
<tr><td rowspan="4">FEXYh</td><td colspan="2">Set Output Level. This command sets the speech output level to one of 255 values as follows:</td><td rowspan="4">None.</td></tr>
<tr><td>FE03</td><td>Set minimum output level.</td></tr>
<tr><td>FE80h</td><td>Set output level half way (default).</td></tr>
<tr><td>FEFEh</td><td>Set maximum output level.</td></tr>
</table>

Request

<table>
<tr><th>Opcode</th><th>Action</th><th colspan="2">Return Value</th></tr>
<tr><td rowspan="8">F500h</td><td rowspan="8">Status Request. This command causes the MSM6679AL-110 to return a 2-byte value indicating its current status.</td><td>F500h</td><td>MSM6679AL-110 ready.</td></tr>
<tr><td>F520h</td><td>MSM6679AL-110 disabled.</td></tr>
<tr><td>F540h</td><td>MSM6679AL-110 waiting for start.</td></tr>
<tr><td>F560h</td><td>MSM6679AL-110 waiting for end.</td></tr>
<tr><td>F580h</td><td>MSM6679AL-110 processing.</td></tr>
<tr><td>F5A0h</td><td>Download/upload in progress.</td></tr>
<tr><td>F5C0h</td><td>Download/upload complete.</td></tr>
<tr><td>F5E0h</td><td>Select/jump complete.</td></tr>
<tr><td>F501h</td><td>Select last FLASH bank for SI recognition.</td><td colspan="2"></td></tr>
<tr><td>F510h</td><td>Select download RAM bank for SI/SP template area. This command enables the download RAM bank in the upper 32 K of data memory for SI recognition.</td><td colspan="2">No return value</td></tr>
<tr><td>F520h</td><td>Select buffer RAM bank for SI/SP. This command enables the buffer RAM bank in the upper 32 K of data memory for SI recognition.</td><td colspan="2">No return value</td></tr>
</table>

Request (Continued)

Opcode	Action	Return Value	
F502h	Download/Upload. Full syntax: F5 02 00 Ctl AdH AdL NH NL [Dt1... DtN [Dt(N+1)]] Full syntax: F5 02 00 Ctl AdH AdL NH NL [Dt1... DtN [Dt(N+1)]] Ctl(7) = 0 for download, Ctl(7) = 1 for upload Ctl(6) = 0 for data RAM, Ctl(6) = 1 for program RAM/ROM If Ctl(6)=0 then Ctl(1-0) = Seg: Data segment selection If Ctl(6)=1 and Ctl(1-0) = x0, then external program segment 0 is used. If Ctl(6)=1 and Ctl(1-0) = x1, then external program segment 1 is used. AdH AdL = high, low bytes of starting address. NH NL = high, low bytes of N N = Number of bytes to be downloaded or uploaded (maximum 07FFCh) Dt1... DtN = Download data. Note (here and in upload response) that data are 8-bit binary values, even if using the serial interface. Dt(N+1). If N is odd, an extra byte is appended to the data so that the total number of bytes in the message remains even. This command requests data transfer to/from data or external program memory.The control parameter (Ctl) controls the direction of the transfer (i.e., download vs. upload) and specifies which of six 64-Kbyte memory segments (i.e., four data segments and two external program segments) is to be accessed. This command does not work with internal program memory. It is not possible to download to external program memory while running in external program memory. The address and length parameters (AdH AdL NH NL) specify the starting address and length of the transfer in bytes. Since the MSM6679AL-110 can only perform download /upload transfers within one 32-Kbyte block in one Download /Upload command, the address and length parameters must not specify a transfer that violates a 32-Kbyte address boundary. If this restriction is violated, the download/upload request will be denied.	Immediately after receiving parameter NL, the MSM6679AL-110 responds with a message to indicate acceptance or denial of the transfer request. Acceptance is indicated by F5A0h. Denial is indicated by a F8XYh. At the end of an accepted transfer, the MSM6679AL-110 re-sponds with a message to confirm or deny valid completion of the transfer. Valid completion is indicated by F5C0h.	
		F880h	Invalid message received.
		F840h	Sample data over-run.
		F820h	32-Kbyte block boundary violation error.
		F810h	Unclassified download/upload error.
		F808h	Divide-by-zero error.
		F804h	Select/jump error.
		F802h	Invalid SP header or table.
		F801h	Reserved.
		FAXYh	Most and least significant byte of ad-dress where error occurred.
		FBXYh	
F504h	Retrieve MSM6679AL-110 Firmware Revision Number.	XXXX	Four-digit ASCII number.

Request (Continued)

Opcode	Action	Return Value	
F505h	Initialize in Background. Background noise initialization is performed for 500 ms. The MSM6679AL-110 requires this command prior to recognition for noise vector subtraction during the utterance sampling period. Use the background initialization command whenever there is a change in the background noise level. For example, sample the noise signature in a vehicle at rest and moving at 35 MPH with its windows rolled down. The quality of a phone line connection can also vary from call to call. The host MCU must implement a strategy as to when to issue a background initialization command. In a vehicle, the host MCU could monitor the vehicle speed, fan speed, radio volume, etc. Alternatively, the host MCU could issue this command each time a new recognition session starts or a new line connection is established. However, the 0.5-sec sample period could degrade system responsiveness if used too frequently. A zero in this bit location during the F2XXh command will not cause an initialization. The F2xxh command can also be used to perform background noise initialization.	F501h	Initialization is complete.
F506h	Retrieve Vocabulary and Trigger Table Revision Number.	XXXX	Four digit ASCII number.
F507h	Save SDR templates in last FLASH. Save the download RAM bank SD template area. Saves 2684 bytes from the address set by the F103 command to the address range F300-FD7F in the last FLASH. The default is 4A00-547B→F300-FD7F).	F501h	Save is complete.
F508h	Get SDR templates from last FLASH. Get the download RAM bank SD template area. Saves 2684 bytes to the address set by the F103 command from the address range F300-FD7B in the last FLASH. The default is (F300-FD7B→4A00-547B).	No return value	
F509h	Select Default SI Vocabulary. (First FLASH)	—	—

Record

Opcode	Action	Return Value	
F101h 00XXh	Set Name Tag Length, Set MSM665x Busy Mode ON. Name tag record length is set by XXh, with XXh defining record length in 14-ms intervals. The maximum record length of FFh yields a recording interval of 3.57 sec. The default value is 1.2 sec.	F101h 00XXh	Operation complete.
F105 xxxx	Set Name Tag Record Origin. This command sets the beginning address for recording name tags. XXXX = 128 byte blocks from 0000 to 02FF. The reset default is 0000. This is only effective before an F50A command since new recordings start after the end of the previous recording. The F50A command uses this num-ber to calculate the first address.	F105 BAAA, where B is the bank num-ber (0,1,2), and AAA is the bank ad-dress /16 (800 - FF8)	
F106 xxxx	Set Name Tag Record End. This command sets the ending address for recording name tags. XXXX = 128 byte blocks from 0000 to 02FF. The reset default is 01FF.	F106 BAAA, where B is the bank num-ber (0,1,2), and AAA is the bank ad-dress /16 (800 - FF8)	
F50Ah	Clear Name Tag Table.	F501h	Name tag table cleared.
F50Ch	Recall name tag pointers from first FLASH. Save the first FLASH name tag pointers (FD80 - FFFF) to the working name tag pointer table. The default is (FD80-FFFF→5480-56FF).	F501h	Saved name tag table recalled.
F51Ch	Recall name tag pointers from last FLASH. Save the last FLASH name tag pointesr (FD80 - FFFF) to the working name tag pointer table. The default is (FD80-FFFF→5480-56FF).	F501h	Name tag pointers recalled.
F50Dh	Save name tag pointers in first FLASH. Save the working name tag pointer table to the first FLASH name tag pointers. The default is (5480 -56FD→FD80-FFFD).	F501h	Name tag table saved.
F51Dh	Save name tag pointers in last FLASH. Save the working name tag pointer table to the last FLASH name tag pointers. The default is (5480 -56FD→FD80-FFFD).	F501h	Name tag pointers saved.
F50Eh	Set Record Volume HIGH.	—	—
F50Fh	Set Record Volume to Normal. This is the default setting.	—	—
FA00h	Reserved. This command is reserved for future use.	—	—
FA01h ~ FA3Dh	Record Name Tag.	FA00h	Completed.
		F280h	Memory full.

Record (Continued)

Opcode	Action	Return Value	
FA3Dh ~ FAFFh	Reserved. These commands are reserved for future use.	—	—

SD Recognition Control

Opcode	Action	Return Value	
Recognition performance is largely a function of how well the enrollment data represents subsequent tokens of the enrolled utterances, and performance generally improves steadily with each additional enrollment pass. For most applications, three initial enrollment passes are recommended. Subsequent reference updating can be performed with the SD Recognize Update command (F342).			
F521h	Clear SDR table. This command initializes a blank SD template table. The 2684-byte area from the address set by the F103 command (the working SDR table) is set to zeros. The SDR tables in the FLASH banks are not affected. The default is (4A00 - 547B).	F501h	SDR table is cleared
F6XYh	Set SD Segment Pointer. This command sets the SD segment pointer to XY00h, i.e., set the starting address of the current SD recognition parame-ter table to XY00h. Issuing this command is equivalent to issuing the Set SD Origin command, F103h XY00h. (For further details of operation, please refer to the description of that command.)	No return value.	
F9XYh	Search for SD Utterance XY. This is the first step in adding an utterance to the vocabulary, or in replacing an existing one. The SD vocabulary memory is searched for utt. no. XYh. If it is not found and if sufficient SD memory exists, the MSM6679AL-110 prepares to add utterance number XYh to the vo-cabulary.	F740h	Utterance number found.
		F700h	Utterance number not found.
		F73Fh	Memory full.
FB00h	Enroll SD Utterance. This command starts MSM6679AL-110 SD Listen mode, then uses the next captured utterance to start or update training of the reference data for SD utterance number XY specified in the most recent Search command (F9XYh). The user must be prompted to say the utter-ance prior to issuing this command. If the utterance was previously enrolled, a training update is performed; if not, the reference data is initialized. Each utterance in the SD vocabulary must be enrolled at least once before it can be recognized.	F740h	Operation complete.
		F700h	Aborting SD Listen mode.
		F73Eh	Improper level, must repeat.
		F802h	Invalid signal processing table.
		F840h	Sample data overrun.
FC00h	Erase utterance from SD vocabulary. This command erases the reference parameters for utterance number XYh from the SD vocabulary, where XYh is the utterance number retained from the previous Search command (F9XYh).	F740h	Operation complete.

Asynchronous Serial Protocol Example

All messages to the MSM6679AL-110 (except downloads and uploads) are echoed, but replies from the MSM6679AL-110 to the host are not echoed by the host. This arrangement facilitates manual communication with the MSM6679AL-110 using standard terminals. The following table illustrates the range of MSM6679AL-110 functions.

Comment	Action	Voice Input	Host Command	MSM6679AL-110 Response
Initialize MSM6679AL-110	Host initializes MSM6679AL-110. MSM6679AL-110 acknowledges.		F258	F258 F200
Load trigger tables at 5000h.	Host requests download to data segment 0, starting at location 5000h, of 256 bytes (0100h). MSM6679AL-110 accepts request. Host sends 256 bytes (~0.25 sec at 9600 baud). MSM6679AL-110 indicates download complete.		F502 0000 5000 0100 ...	F502 0000 5000 0100 F5A0 F5C0
Set new triggering origin.	Host requests Set triggering origin to 5000h. MSM6679AL-110 sets triggering origin and sends confirming response.		F104 5000	F104 5000 F104 5000
Download new SD vocabulary.	Host requests download to data segment 0, starting at location 6000h, of 4 Kbytes (1000h). MSM6679AL-110 accepts request. Host sends 4 Kbytes (~4.3 sec at 9600 baud) MSM6679AL-110 indicates download complete.		F502 0000 6000 1000 ...	F502 0000 6000 1000 F5A0 F5C0

Comment	Action	Voice Input	Host Command	MSM6679AL-110 Response
Set new SD tables.	Host requests Set SD origin to 6000h. MSM6679AL-110 sets SD origin and responds.		F103 6000	F103 6000 F103 6000
Download first 4 K of SI vocabulary.	Host requests download to data segment 0, starting at location 7000h, of 4k bytes (1000h). MSM6679AL-110 accepts request. Host sends 4 Kbytes. MSM6679AL-110 indicates download complete.		F502 0000 7000 1000 ...	F502 0000 7000 1000 F5A0 F5C0
Download last 32 K of SI vocabulary.	Host requests download to data segment 0, starting at location 8000h, of 32k bytes (7FFC). MSM6679AL-110 accepts request HOST sends 32 Kbytes. MSM6679AL-110 indicates download complete.		F502 0000 8000 7FFC ...	F502 0000 8000 7FFC F5A0 F5C0
Set new SP/SI tables.	Host requests Set SP/SI origin = 7000h. MSM6679AL-110 sets SP/SI origin and responds.		F102 7000	F102 7000 F102 7000
Upload data for diagnostics.	Host requests upload from data segment 0, starting at location 300h, of 45 bytes (2Dh). MSM6679AL-110 accepts request, signals in progress. MSM6679AL-110 sends 46 bytes. MSM6679AL-110 indicates upload complete.		F502 00A0 0300 002D	F502 00A0 0300 002D F5A0 ... F5C0
Set up MSM6679AL-110 for SI recognition.	Host requests set SP table 3. MSM6679AL-110 selects SP table 3 and confirms. Host initializes MSM6679AL-110. MSM6679AL-110 acknowledges.		F123 F258	F123 F123 F258 F200
SI recognition.	Host starts SI recognition, vocabulary 1. MSM6679AL-110 recognizes utterance 3. Host starts SI recognition, vocabulary 2. MSM6679AL-110 recognizes utterance 2. Host starts SI recognition, vocabulary 2. MSM6679AL-110 recognizes utterance 3.	"Dial" "Two" "Three"	F301 F302 F302	F301 F603 F302 F602 F302 F603

Comment	Action	Voice Input	Host Command	MSM6679AL-110 Response
SI recognition.	Host starts SI recognition, vocabulary 1.		F301	F301
		"Store"		
	MSM6679AL-110 recognizes utterance 1.			F601
SD enrollment.	Get ready to train SD utterance 1.		F901	F901
	Memory is empty and ready to train.			F700
	Pass 1; host sends SD enroll command.		FB00	FB00
		"John Smith"		
	SD utterance 1 initialized.			F740
	Pass 2; host sends SD enroll command.		FB00	FB00
		"John Smith"		F740
	SD utterance 1 updated.			FB00
	Pass 3. Host sends SD enroll command.		FB00	
		"John Smith"		F740
	SD utterance 1 updated.			
SI recognition of control words.	Host starts SI recognition, vocabulary 1.		F301	F301
		"Dial"		
	MSM6679AL-110 recognizes utterance 3.			F603
	Host starts SI recognition, vocabulary 2.		F302	F302
		"Five"		
	MSM6679AL-110 recognizes utterance 5.			F605
	Host starts SI recognition, vocabulary 2.		F302	F302
		"Six"		
	MSM6679AL-110 recognizes utterance 6.			F606
	Host starts SI recognition, vocabulary 1.		F301	F301
		"Store"		
	MSM6679AL-110 recognizes utterance 7.			F601
SD enrollment.	Host prepares MSM6679AL-110 to train SD utterance 2		F902	F902
	Memory is empty and ready to train.			F700
	Pass 1; host sends SD enroll command.		FB00	FB00
		"Bill Jones"		
	SD utterance 2 initialized.			F740
	Pass 2; host sends SD enroll command.		FB00	FB00
		"Bill Jones"		
	MSM6679AL-110 updates SD utterance 2.			F740
	Pass 3; host sends SD enroll command.		FB00	FB00
		"Bill Jones"		
	MSM6679AL-110 signals operation completed.			F740
SI recognition of control word.	Host starts SI recognition, vocabulary 1.		F301	F301
		"Directry"		
	MSM6679AL-110 recognizes utterance 3.			F603
SD recognition.	Host starts SD recognition.		F340	F340
		"John Smith"		
	MSM6679AL-110 signals trigger OK.			F740
	Host sends SD sort command.		F341	F341
	MSM6679AL-110 recognizes utterance 1.			F701

Comment	**Action**	**Voice Input**	**Host Command**	**MSM6679AL-110 Response**
Name tag recording.	Host initiates MSM665x port.		F480	F480
	Host sets recording length to 1 sec.		F101 0047	F101 0047
	MSM6679AL-110 signals operation complete.			F101 0047
	Host clears name tag table		F50A	F50A
	MSM6679AL-110 signals operation complete.			F501
	Host sets record gain to max. level.		F50E	F50E
	Start recording tag one.		FA01	FA01
		"Jane Doe"		
	MSM6679AL-110 signals name tag recording complete.			FA00
	Save name tags to FLASH.		F50D	F50D
	Name tags saved.			F501
Name tag playback.	Host sets volume to max. level.		FEFF	FEFF
	Host commands play back name tag 1.		F401	F401
				"Jane Doe"
	MSM6679AL-110 signals playback OK.			F400
Sound playback.	Host sets output volume to mid point.		FE80	FE80
	Play MSM6679AL-110 internal sound 1.		F442	F442
				"bzzzz"
	Play back sound from MSM6654.		F49F	F49F
				"Completed"

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