Ordering number : ENN*7809

Preliminary

SANYO Semiconductors

DATA SHEET

Monolithic Linear IC

LV1605M — Analog Signal Processor for CD Players

Overview

The LV1605M implements the analog signal processing and servo control required by compact disc players, and, when combined with a CD DSP such as the LC78604E or LC78605E, can implement a CD player with a minimal parts count. The LV1605M also provides a gain switching pin to allow it to support playback of CD-RW discs.

Functions

IV amplifier, RF amplifier (with AGC and hold function on defect detection), APC, FE (with VCA), TE (with VCA and auto-balance), focus servo amplifier (with offset canceller and hold function on defect detection), tracking servo amplifier (with offset canceller and hold function on defect detection), spindle servo amplifier (with gain switching function and hold function on defect detection), sled servo amplifier (with on/off function and hold function on defect detection), focus detection (DRF and FZD), track detection (HFL and TES), defect detection, shock detection, and disc mode gain switching function.

Features

- The LV1605M provides the following automatic adjustment functions.
  - Focus offset, auto canceller: FE (pin 21)
  - Tracking offset, auto canceller: TE (pin 7)
  - E/F balance automatic adjustment
  - RF level AGC function
  - Tracking servo gain RF level following function
  - Focus servo gain RF level following function
- Focus search smoothing setting pin: FSC (pin 58)
- Focus search mode switching pin: FSS (pin 54)
- Play disc mode (normal or CD-RW) switching pin: RW (pin 44)

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Specifications

Absolute Maximum Ratings at Ta=25°C, pins 33, 57=GND

Parameter	Symbol	Conditions	Ratings	Unit
Maximum supply voltage	V_{CC} max	Pins 32, 51	5	V
Allowable power dissipation	Pd max		200	mW
Operating temperature	Topr		–25 to +70	°C
Storage temperature	Tstg		–40 to +125	°C

Operating Condition at pins 33, 57=GND

Parameter	Symbol	Conditions	Ratings	Unit
Recommended supply voltage	V_{CC}		3.3	V
Allowable operating supply voltage range	V_{CC}op		3.0 to 3.6	V

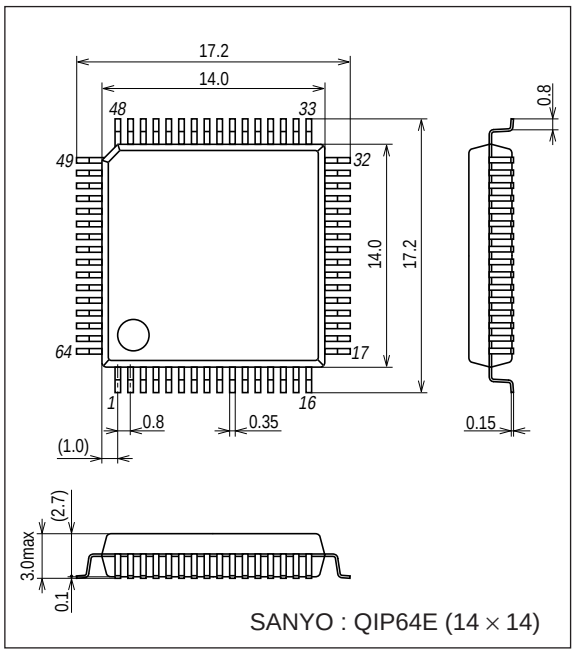
* Operating Supply Voltage at Limit of Operating Temperature, pins 33, 57=GND

Parameter	Symbol	Conditions	Ratings	Unit
Operating ambient temperature	Topr2		–10 to +75	°C
Allowable operating supply voltage range	V_{CC}op2		3.0 to 3.6	V

Package Dimensions

unit : mm

3159A



Electrical Characteristics/Operating Characteristics at Ta=25°C, with V_{CC} (pins 32, 51)=3.3V, GND (pins 33, 57)=0V

Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Current drain (active mode)	ICCO	AV_{CC} (pin32) + DV_{DD} (pin51), pin55=3.3V	5	16	30	mA
Current drain (sleep mode)	ICCs	AV_{CC} (pin32) + DV_{DD} (pin51), pin55=0V		7.5		mA
Reference voltage	VREF	VR	1.50	1.65	1.80	V
Interface: CE - Vtp	CEvtp	CE		1.9		V
Interface: CE - Vtn	CEvtn	CE		1.2		V
Interface: CL - Vtp	CLvtp	CL		1.9		V
Interface: CL - Vtn	CLvtn	CL		1.2		V
Interface: DAT - Vtp	DATvtp	DAT		1.9		V
Interface: DAT - Vtn	DATvtn	DAT		1.2		V
Interface: Maximum CL frequency	CLmax		500			kHz
RF amplifier: RFSM no signal voltage	RFSMo	RW=H, L	0.60	1.15	1.70	V
RF amplifier: Minimum gain (normal)	RFSMgmin1	FIN1, FIN2: 100kΩ-input, PH1=2.65V RW=H, freq-200kHz, RFSM	0.5	4.5	8.5	dB
RF amplifier: Minimum gain (CD-RW)	RFSMgmin1	FIN1, FIN2: 100kΩ-input, PH1=2.65V RW=L, freq-200kHz, RFSM	12.5	16.5	20.5	dB
Focus amplifier: FDO gain MIN (Normal)	FDg1	FIN1, FIN2: 100kΩ-input, FIN1=–FIN2, RW=H, FDO, SCI=VR, PH1=2.65V, freq-10kHz, FD	–3.5	+0.5	+4.5	dB
Focus amplifier: FDO gain MIN (CD-RW)	FDg2	FIN1, FIN2: 100kΩ-input, FIN1=–FIN2, RW=H, FDO, SCI=VR, PH1=2.65V, freq-10kHz, FD		+12.5		dB
Focus amplifier: FDO gain MAX (Normal)	FDg1	FIN1, FIN2: 100kΩ-input, FIN1=–FIN2, RW=H, FDO, SCI=VR, PH1=1.0V, freq-10kHz, FD		+6.5		dB
Focus amplifier: FDO gain MAX (CD-RW)	FDg2	FIN1, FIN2: 100kΩ-input, FIN1=–FIN2, RW=L, FDO, SCI=VR, PH1=1.0V, freq-10kHz, FD		+18.5		dB
Focus amplifier: FDO offset (Normal)	FDost1	The difference from the reference voltage, RW=high, servo on, FH=VR	–300	0	+300	mV
Focus amplifier: FDO offset (CD-RW)	FDost2	The difference from the reference voltage, RW=low, servo on, FH=VR	–450	0	+450	mV
Focus amplifier: Offset when off (Normal)	FDofost1	The difference from the reference voltage, RW=high, servo off, FH=VR	–100	0	+100	mV
Focus amplifier: Offset when off (CD-RW)	FDofost2	The difference from the reference voltage, RW=low, servo off, FH=VR	–100	0	+100	mV
Focus amplifier: Offset adjustment step	FEstep	FE		18		mV
Focus amplifier: F search voltage H1	FSmax1	FDO, FSS=ground, the difference from VR		0.25		V
Focus amplifier: F search voltage L1	FSmin1	FDO, FSS=ground, the difference from VR		–0.25		V
Focus amplifier: F search voltage H2	FSmax2	FDO, FSS=V_{CC}, the difference from VR		0.25		V
Focus amplifier: F search voltage L2	FSmin2	FDO, FSS=V_{CC}, the difference from VR		0		V
Tracking amplifier: TE gain MAX (CD)	TEgmax1	freq-10kHz, E, F: 180kΩ-input, E=–F, PH1=1.0V, RW=H, TE	+17.5	+21.75	+26.0	dB
Tracking amplifier: TE gain MAX (CD-R)	Tegmax2	freq-10kHz, E, F: 180kΩ-input, E=–F, PH1=1.0V, RW=H, TE		+18.75		dB
Tracking amplifier: TE gain MAX (CD-RW)	Tegmax3	freq-10kHz, E, F: 180kΩ-input, E=–F, PH1=1.0V, RW=L, TE		+33.75		dB
Tracking amplifier: TE gain MIN (CD)	TEgmin1	f=10kHz, E, F: 180kΩ-input, E=–F, PH1=2.65V, RW=H, TE	+11.5	+15.0	+18.5	dB
Tracking amplifier: TE gain MIN (CD-R)	Tegmin2	f=10kHz, E, F: 180kΩ-input, E=–F, PH1=2.65V, RW=H, TE		+12.0		dB
Tracking amplifier: TE gain MIN (CD-RW)	Tegmin3	f=10kHz, E, F: 180kΩ-input, E=–F, PH1=2.65V, RW=L, TE	+23.0	+27.25	+31.5	dB
Tracking amplifier: ΔTE (200k)	ΔTE_{200k}	E, F:180kΩ-input, RW=H, E=–F, TE, ΔTE200k=TE (10kHz) – TE(200kHz)		12.0		dB
Tracking amplifier: TGL offset (Normal)	TGLost1	Servo: on, TH=VR, TGL=H, RW=H, TO	–250	0	+250	mV
Tracking amplifier: TGL offset (CD-RW)	TGLost2	Servo: on, TH=VR, TGL=H, RW=L, TO	–450	0	+450	mV
Tracking amplifier: THLD offset (Normal)	THLDost1	THLD mode, RW=high, the difference from VR, TA	–120	0	+120	mV
Tracking amplifier: THLD offset (CD-RW)	THLDost2	THLD mode, RW=low, the difference from VR, TA	–120	0	+120	mV
Tracking amplifier: Off 1 offset	OFF1ost	TOFF=H, TO	–120	0	+120	mV
Tracking amplifier: Off 2 offset	OFF2ost	TOF2 off (IF), TO	–120	0	+120	mV
Tracking amplifier: Offset adjustment step	TEstep	TE		40		mV
Tracking amplifier: Balance range - high	BAL-H	Δgain E/F input, TB=3.3V		+3.5		dB
Tracking amplifier: Balance range - low	BAL-L	Δgain E/F input, TB=0V		–3.5		dB

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Parameter	Symbol	Conditions	Ratings			Unit
			min	typ	max	
Tracking servo switching threshold TOFF-VTH	TOFFvth		+1.0		+2.05	V
Tracking gain switching threshold TGL-VTH	TGLvth		+1.0		+3.05	V
PH No signal voltage	PHo	The difference from RFSM	–0.9	–0.65	–0.4	V
BH No signal voltage	BHo	The difference from RFSM	+0.4	+0.65	+0.9	V
DRF Detection voltage	DRFvth	The difference from VR at RFSM	–0.40	–0.2	0	V
DRF Output voltage - high	DRF-H		+2.7	+3.15		V
DRF Output voltage - low	DRF-L			0	+0.5	V
FZD Detection voltage 1	FZD1	FE, the difference from VR	0	+0.2		V
FZD Detection voltage 2	FZD2	FE, the difference from VR		0		V
HFL Detection voltage	HFLvth	The difference from VR at RF		–0.18		V
HFL Output voltage - high	HFL-H		+2.4	+3.15		V
HFL Output voltage - low	HFL-L			0	+0.5	V
TES Detection voltage LH	TES-LH	TESI, the difference from VR	–0.15	–0.085	–0.02	V
TES Detection voltage HL	TES-HL	TESI, the difference from VR	+0.02	+0.085	+0.15	V
TES Output voltage - high	TES-H		+2.3	+3.15		V
TES Output voltage - low	TES-L			0	+0.5	V
JP Output voltage - high	JP-H	TJP=3.3V, at SLD		+1.0		V
JP Output voltage - low	JP-L	TJP=0V, at SLD		–1.0		V
Spindle amplifier: Offset12	SPD12ost	The difference from VR at SPD, 12cm mode	–100	0	+100	mV
Spindle amplifier: Offset8	SPD8ost	The difference from VR at SPD, 8cm mode	–100	0	+100	mV
Spindle amplifier: Offset off	SPDof	The difference from VR at SPD, off mode	–120	0	+120	mV
Spindle amplifier: Output voltage H12	SPD-H12	The difference from offset 12, 12cm mode, CLV=3.3V	+0.3	+0.5	+0.8	V
Spindle amplifier: Output voltage L12	SPD-L12	The difference from offset 12, 12cm mode, CLV=0V	–0.8	–0.5	–0.3	V
Spindle amplifier: Output voltage H8	SPD-H8	The difference from offset 8, 8cm mode, CLV=3.3V	+0.1	+0.23	+0.36	V
Spindle amplifier: Output voltage L8	SPD-L8	The difference from offset 8, 8cm mode, CLV=0V		–0.23		V
Sled amplifier: SLEQ offset	SLDost	The difference from TO at SLEQ	–70	0	+70	mV
Sled amplifier: Offset SLD	SLDost	The difference from VR when SLEQ=VR	–180	0	+280	mV
Sled amplifier: Offset off	SLDof	Off mode	–180	0	+280	mV
Disc switching: RW-VTH	RWvth	RW	+1.0	+1.65	+2.3	V
Anti-shock: No signal voltage	SCIo	SCI, the difference from VR	–70	0	+70	mV
Anti-shock: Detection voltage - high	SCIvthH	SCI, the difference from VR	+20	+80	+140	mV
Anti-shock: Detection voltage - low	SCIvthL	SCI, the difference from VR	–140	–80	–20	mV
Defect: Detection voltage	DEFvth	With RFSM=2.0V, the difference between the LF2 voltage on disc defect detection and the LF2 voltage when RF=2.0V.	+0.10	+0.35	+0.60	V
Defect: Output voltage - high	DEF-H		2.4	3.0		V
Defect: Output voltage - low	DEF-L			0	+0.5	V
APC: Reference voltage	LDS	The LDS voltage such that LDD=1.65V	+100	+170	+240	mV
APC: Off voltage	LDDof	LDD	+2.85	+3.15		V

Pin Functions

Pin No.	Pin name	I/O	Description
1	FIN2	I	Pickup photodiode connection. The RF signal is generated by adding to the FIN1 pin, and the FE signal is generated by subtracting.
2	FIN1	I	Pickup photodiode connection
3	E	I	Pickup photodiode connection. The TE signal is generated by subtraction with the F pin.
4	F	I	Pickup photodiode connection
5	TB	I	TE signal DC component input
6	TE–		The TE signal gain is set by connecting a resistor between this pin and the TE pin.
7	TE	O	TE signal output
8	TESI	I	TES (tracking error sense) comparator input. Apply a bandpass filter to the TE signal and input the result to this pin.
9	SCI	I	Shock detection input
10	TH		Tracking gain time constant setting
11	TA		TA amplifier output
12	TD–		Used for the tracking phase compensation constant formed between the TD and VR pins.
13	TD	I	Tracking phase compensation constant connection
14	JP		Tracking jump signal (kick pulse) amplitude setting
15	TO	O	Tracking control signal output
16	FD	O	Focusing control signal output
17	FD–		Used for the focusing phase compensation constant formed between the FD and FA pins.
18	FA		Used for the focusing phase compensation constant formed between the FD- and FA- pins.
19	FA–		Used for the focusing phase compensation constant formed between the FA and FE pins.
20	FHO		Focus gain time constant setting
21	FE	O	FE signal output
22	FE–		The FE signal gain is set by connecting a resistor between this pin and the FE pin.
23	FH		Focus gain time constant setting
24	SP	O	CLV input signal single-end output
25	SPG		Spindle 12 cm mode gain setting resistor connection
26	SP–		Used for the spindle phase compensation constant in conjunction with the SPD pin.
27	SPD	O	Spindle control signal output
28	SLEQ		Sled phase compensation constant setting
29	SLD	O	Sled control signal output
30	SL–	I	Input for the sled advance signal from the microcontroller.
31	SL+	I	Input for the sled advance signal from the microcontroller.
32	DVCC		Digital system V_{CC}
33	DGND		Digital system ground
34	TGL	I	Input for tracking gain control signal from the DSP. The gain is low when TGL is high.
35	TOFF	I	Input for tracking gain control signal from the DSP. The gain is off when TOFF is high.
36	TES	O	Outputs for the TES signal to the DSP.
37	TJP	I	Input for the tracking jump signal from the DSP
38	HFL	O	The high frequency level (HFL) signal is used to judge whether the position of the main beam is over a pit or over a mirror area.
39	CLV	I	CLV error signal from the DSP
40	INTI	I	Forced defect detected state signal input
41	CL	I	Microcontroller command clock input
42	DAT	I	Microcontroller command data input
43	CE	I	Microcontroller command chip enable input
44	RW	I	Gain switching input. RW=high: CD mode, RW=low: CD-RW mode.
45	CLK	I	Reference clock input. The DSP 130kHz clock signal is input to this pin.
46	DEF	O	Disc defect detection output
47	DRF	O	Defect RF: RF level detection output
48	RFSM	O	RF output
49	RF–		In conjunction with the RFSM pin, sets the RF gain and is used for the EFM signal 3T compensation constant setting.
50	PH1		RF signal peak hold capacitor connection
51	AVCC		Analog system V_{CC}.
52	NC		NC (no connection)
53	FAJON	I	Focus offset adjustment mode switching. FAJON=low: normal mode, FAJON=high: constant voltage FD mode.
54	FSS	I	Focus search select (FSS): focus search mode (± or + search relative to the reference voltage) switching.
55	PON	I	Power On. PON=high: active mode, PON=low: sleep mode
56	LF2		Disc defect detection time constant setting
57	AGND		Analog system ground
58	FSC		Focus search smoothing capacitor connection
59	BH1		RF signal bottom hold capacitor connection
60	REFI		Reference voltage bypass capacitor connection
61	VR	O	Reference voltage output
62	LDD	O	APC circuit output
63	LDS	I	APC circuit input
64	TC		Tracking signal peak hold capacitor connection

Switching Characteristics

Relationships Between Control Pin Voltages and Operating Modes
(VCC (pins 32, 51)=3.3V, GND (pins 33, 57=0V)

TGL (pin 34) Tracking gain switching

Mode	Min	Max
High gain	0V	0.5V
Low gain	3.05V	3.3V

TOFF (pin 35) Tracking servo on/off switching

Mode	Min	Max
Tracking servo: on	0V	0.5V
Tracking servo: off	2.05V	3.3V

INTI (pin 40) Forces the defect detection signal to the high level

Mode	Min	Max
Defect detected signal forced to high function: on	0V	1.0V
Defect detected signal forced to high function: off	2.0V	3.3V

RW (pin 44) RF and servo system high gain (+12 dB) switching

Mode	Min	Max	Gain increase
CD mode	2.0V	3.3V	Low
CD-RW mode	0V	1.0V	Hi

FAJON (pin 53) Focus offset adjustment mode switching

Mode	Min	Max
Sony coupler mode	2.0V	3.3V
Coupler other than Sony mode	0V	1.0V

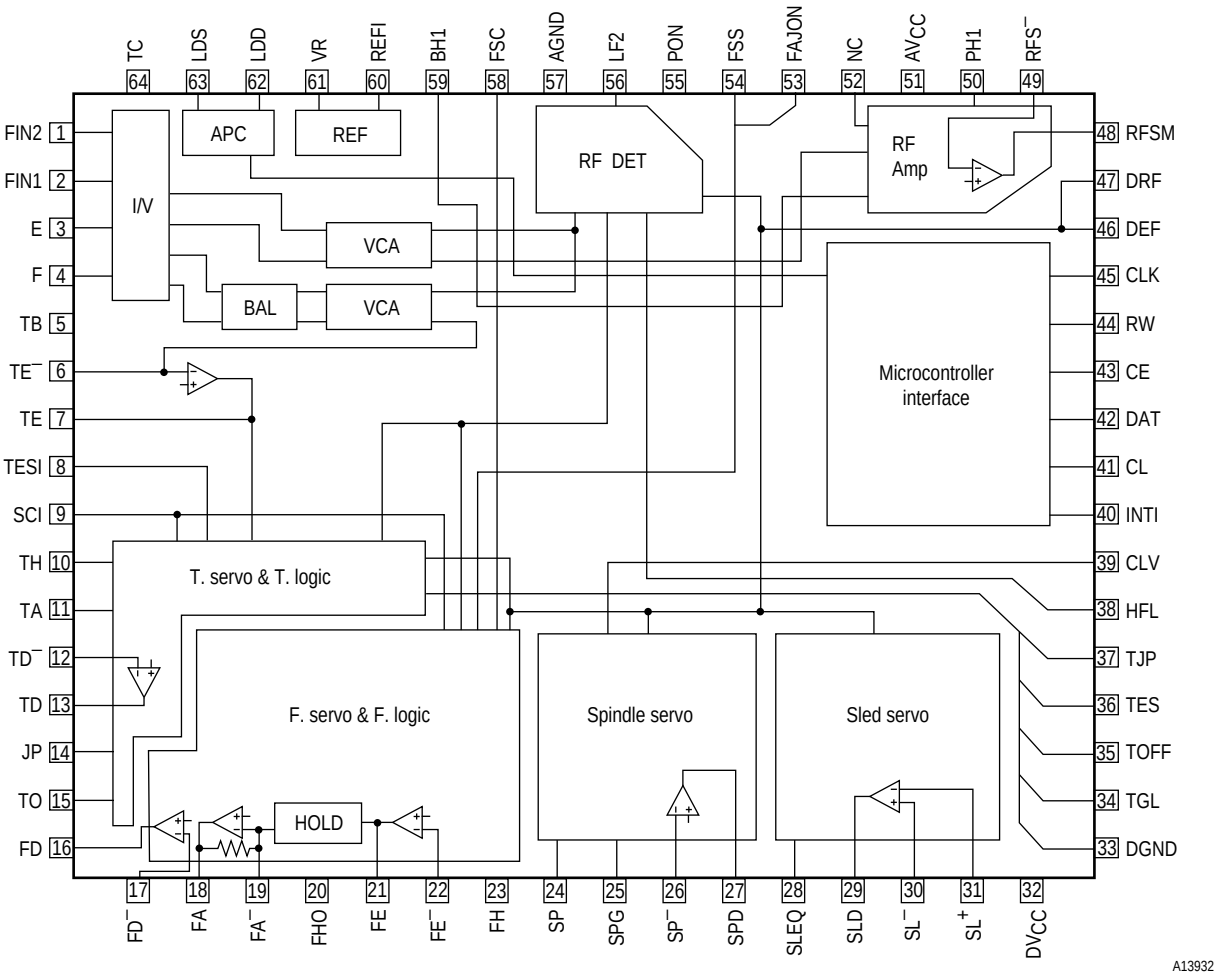
FSS (pin 54) Focus search mode switching

Mode	Min	Max
Search ± relative to the reference voltage	3.0V	3.3V
Search only in the + direction relative to the reference voltage	0V	0.5V

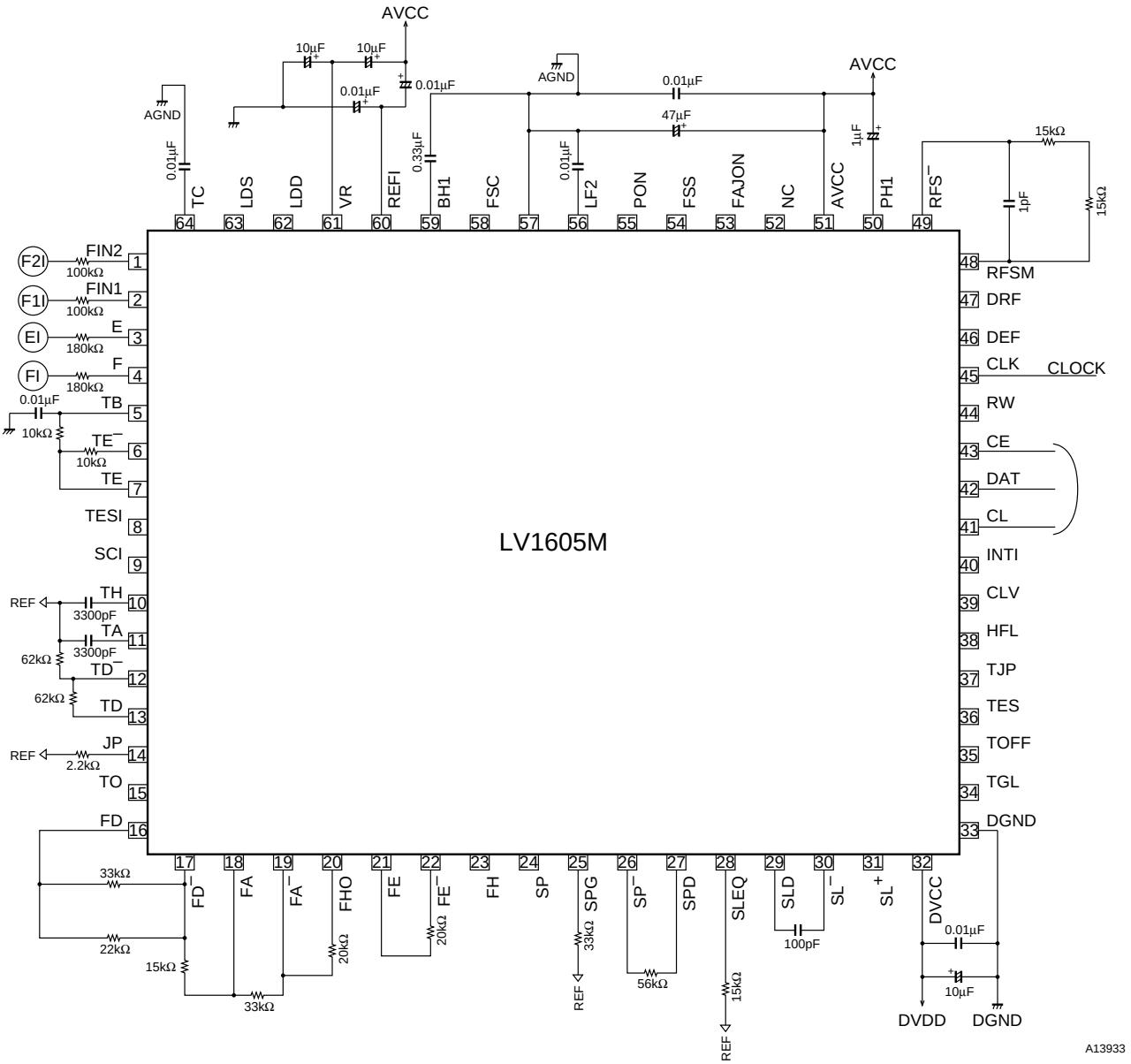
PON (pin 55) Sleep mode switching

Mode	Min	Max
Active mode	3.0V	3.3V
Sleep mode	0V	0.5V

Equivalent Circuit



Test Circuit



Operational Description

- APC (Automatic laser power control)
  This circuit is provided to control the pickup laser power. The laser on/off state is set by the microcontroller.

- RF amplifier (eye pattern output)
  The (A + C) component of the pickup photodiode output current is input to FIN2 (pin 1), and the (B + D) component is input to FIN1 (pin 2). The input current is converted to a voltage. That signal is passed through the AGC circuit and output from the RFSM amplifier output RFSM pin (pin 48). The internal AGC circuit has a variable gain range of ±3 dB, and its time constant can be changed by adjusting the value of the external capacitor connected to PH1 (pin 50). The bottom level of the EFM signal (the RFSM output) is controlled, and the response of this function can be changed by adjusting the value of the external capacitor connected to BH1 (pin 59). The center value of the range of the AGC circuit is set by the value of the resistor inserted between RFSM (pin 48) and RFS- (pin 49). If required, these pins can also be used for EFM signal 3T compensation. When playing CD-RW discs, the input gain is increased when the IC receives a signal from the DSP that sets RW (pin 44) low.

- Focus Servo

  The focus error signal is acquired by detecting the difference (B+D) – (A+C) of the (A+C) and (B+D) signals from the pickup. This focus error signal is then passed through the VCA circuit, whose gain following is controlled by the RF AGC circuit, and is output from FE (pin 21). The gain applied to the focus error signal is set by the value of the resistor connected between FE (pin 21) and FE– (pin 22). When playing CD-RW discs, the input gain is increased when the IC receives a signal from the DSP that sets RW (pin 44) low.

  Offset cancellation is applied to the FE amplifier. This offset cancellation operation is provided to cancel the offset of the IC's internal I-V amplifier and other circuits. Adjustment of this function is started by issuing a FOCUS-OFFSET ADJUST START command and completes about 130ms later. The FOCUS-OFFSET ADJUST OFF command is provided to return the IC's state to the state preceding the offset cancellation operation.

  The FA amplifier is provided as a pickup phase compensation amplifier, and it's equalizer curve is set with an external capacitor and resistor. This amplifier has a muting function, and mutes the output either when an F-SERVO OFF command is issued in V_{CC} ON mode or during an F-SEARCH operation. Issue either a LASER ON or an F-SERVO ON command to turn focus search on.

  The FH amplifier modifies the servo response characteristics on disc defect detection with SCI (pin 9).

  The FD amplifier includes both a phase compensation circuit and a focus search signal synthesis function. A focus search operation is started with the F-SEARCH command, a ramp waveform is generated using an internal clock, and the operation completes in about 560ms. Focus is detected (focus zero cross detection) using the focus error signal created from that waveform, and the focus servo is turned on. The amplitude of the ramp waveform is set by the value of the resistor connected between FD (pin 16) and FD- (pin 17).

  FSC (pin 58) is used to smooth the focus search ramp waveform; a capacitor for this purpose is connected between FSC and REF.

  FSS (pin 54) is the focus search mode switching pin; if FSS is shorted to V_{CC}, the IC performs a + search relative to the reference voltage, and if FSS is left open or shorted to ground, the IC performs a ± search.

  FAJON (pin 53) is the focus offset adjustment mode switching pin, and is normally shorted to ground. Short this pin to V_{CC} to set the IC to operate in Sony coupler mode.

- Tracking servo

  The photodiode output current is input to E (pin 3) and F (pin 4). The input current is I-V converted, and the voltage signal passes through first the balance adjustment VCA circuit and then the VCA circuit, whose gain following is controlled by the RF AGC circuit, and is output from TE (pin 7). The value of the resistor connected between TE- (pin 6) and TE (pin 7) sets the tracking error gain. When playing CD-RW discs, the input gain is increased when the IC receives a signal from the DSP that sets RW (pin 44) low. Furthermore, in E/F balance mode, the gain is lowered by 3 dB when the tracking signal peak value is over VREF + 0.6V.

  Offset cancellation is applied to the TE amplifier. This offset cancellation operation completes in about 60ms. The TRACK-OFFSET ADJUST OFF command is provided to return the IC's state to the state preceding the offset cancellation operation.

  The TH amplifier detects either the TGL signal from the DSP or the JP signal, and changes the servo response characteristics according to the internally generated THLD signal and other signals. The tracking servo switches to THLD mode internally on disc defect detection. This operation can be avoided by simply shorting DEF (pin 46) to ground (the low level). A bandpass filter that extracts just the mechanical shock (skip detection) component from the tracking error signal is formed externally at SCI (pin 9), and if injected, the gain is increased automatically when a shock (skip) is detected.

  The LV1605M includes an internal resistor so that a low-pass filter can be formed at the TA output (pin 11).

  The TD amplifier is a circuit provided for servo loop phase compensation. Its characteristics are set with an external RC circuit. This amplifier has a muting function, and the muting function operates either when V_{CC} is turned on and when a TRACK-SERVO OFF command has been issued. This muting function is released when a TRACK-SERVO ON command is issued.

  The TOFF amplifier immediately following TD (pin 13), functions to turn off the servo according to the TOFF signal from the DSP.

  The TO amplifier includes a function for synthesizing JP pulses, and the JP pulse is set with JP (pin 14). (THLD is detected internally.)

- Sled servo

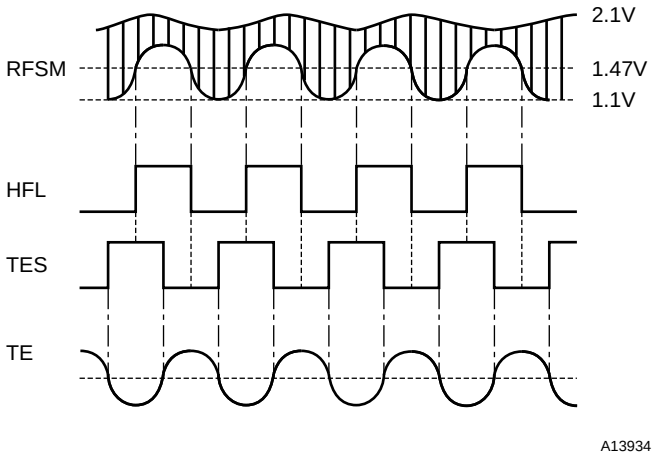
  The response characteristics are set with SLEQ (pin 28). The amplifier that follows SLEQ (pin 28) provides a muting function; that muting function is turned on by the SLED OFF command. The sled is advanced by applying a current input to SL- (pin 29) and SL+ (pin 30). In particular, connect the SLEQ pin to a microcontroller output port via a resistor, and set the sled advance gain by the value of that resistor. Note that an offset in the SLD output will occur if there is a discrepancy between the values of the SL- (pin 29) and SL+ (pin 30) resistors. The muting function also operates on disc defect detection.

- Spindle servo

  A servo circuit to hold the disc at a constant linear speed is formed in conjunction with the DSP. The IC receives a signal from the DSP at CLV (pin 39) and outputs a signal from SPD (pin 27). The equalizer characteristics are set with SP (pin 24), SP- (pin 26), and SPD (pin 27). The 12cm mode amplifier gain is set by the resistor connected between SPG (pin 25) and the reference voltage. In 8cm mode, the amplifier is buffered internally and independent of SPG (pin 25). Note that the gain must first be set for 8cm mode and then set for 12cm mode. Note that circuit can be forcibly set to the 8cm mode gain regardless of the 8/12cm mode setting by setting SPG (pin 25) to the open state. The muting function operates on disc defect detection.

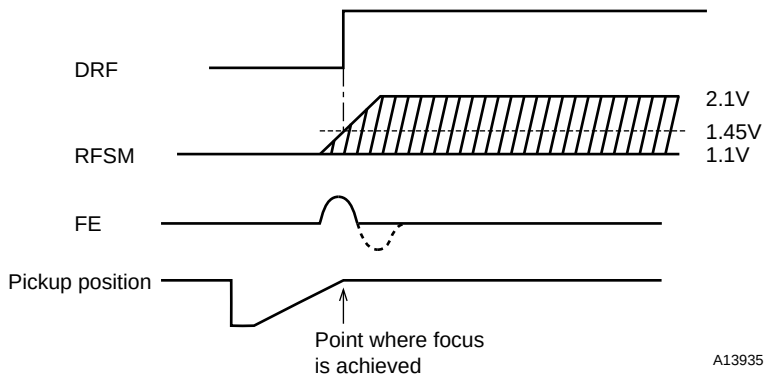
- TES and HFL (traversal signals)

  When the pickup moves from the outside of the disc towards the inside, the EF output from the pickup is connected so that the HFL and TES signals have the phase relationship shown in the figure. The TES comparator is a negative polarity comparator with respect to the TESI input, and has a hysteresis of about ±100mV. A bandpass filter used to extract only the required signal components from the TE signal is formed externally.

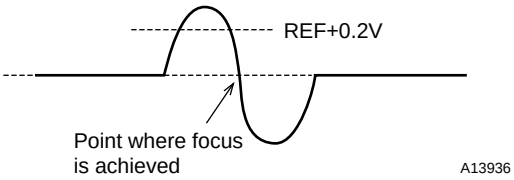


- DRF (optical amplitude judgment)

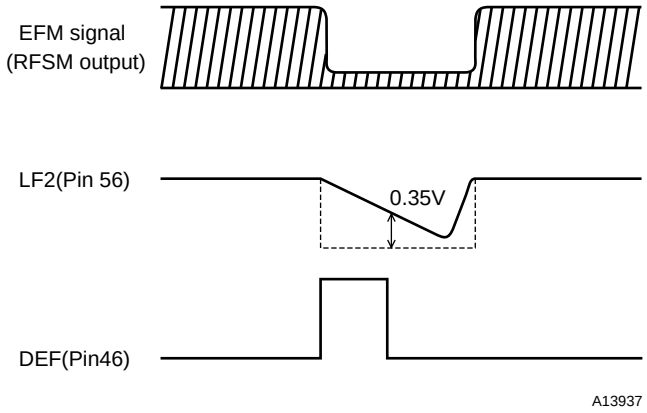
  A peak hold function using the PH1 (pin 50) capacitor is applied to the EFM signal (RFSM output). This circuit outputs a high level when the RFSM peak value exceeds about 1.45V. The PH1 (pin 50) capacitor is related to the settings for both the DRF detection time constant and the RF AGC response.



• Focus judgment
The pickup is judged to get in focus when the Scurve reaches the REF level after the level REF + 0.2 V has been detected in the focus error signal Scurve.

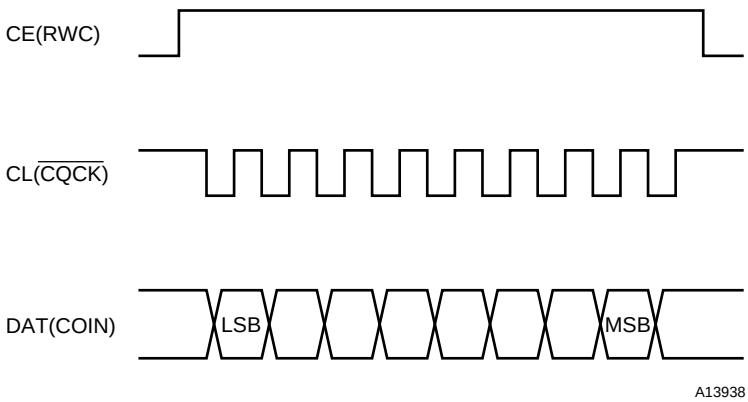


• Disc defect detection
The mirror surface detection level is held by the capacitor connected to LF2 (pin 56), and a high level is output from DEF (pin 46) if the dropout level in the EFM signal (RFSM output) rises above 0.35V. When DEF (pin 46) goes high, the tracking servo goes to THLD mode. To prevent the tracking servo from going to THLD mode when a disc defect is detected, either short DEF (pin 46) or short LF2 (pin 56) to ground. This prevents the DEFECT output from being issued.



• Microcontroller interface
Since the Reset (Nothing) command initializes the LV1605M, it must be used with care. The LV1605M's command acceptance (mode switching) timing is such that the mode switches on the (130kHz) clock cycle following the CE (RWC) falling edge. Therefore, a low-level period in the CE signal of at least 10 µs is required when issuing consecutive commands. The 130kHz clock is required for this reason. The various LV1605M instructions can be issued by setting CE high and then, in synchronization with the CL clock, issuing the command from the microcontroller, LSB first, to DAT (pin 42). Note that commands are executed starting at the fall of the CE signal.

Timing Chart



* Items in parentheses are DSP pin names.

- Reset circuit
  The power on reset is cleared when V_{CC} rises above about 2.0V.

- Notes on PCB pattern design
  Since noise may enter RFSM (pin 48) from CLV (pin 39), shielding must be run between these lines.

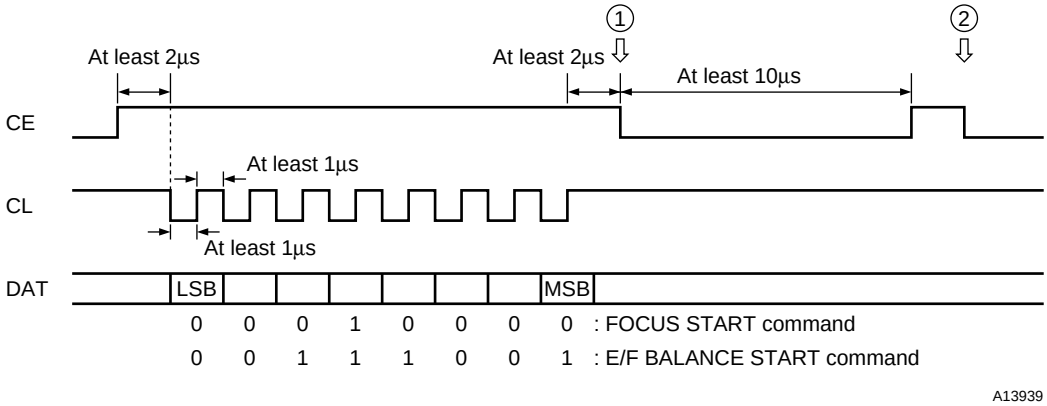
- VCC, REF, GND, and NC pins
  AVCC (pin 51): Analog system
  DVCC (pin 32) Digital system
  AGND (pin 57): Analog system
  DGND (pin 33): Digital system
  NC (pin 52): No connect
  VR (pin 61): Reference voltage

Command Table

MSB							LSB	Command	During a reset During the power on state	DSP
0	0	0	0	0	0	0	0	RESET		RESET (Nothing)
0	0	0	0	1	0	0	0	FOCUS START		FOCUS START#1
1	0	0	1	0	0	0	0	FOCUS-OFFSET ADJUSTMENT START		
1	0	0	1	0	0	0	1	FOCUS-OFFSET ADJUSTMENT OFF	○	
1	0	0	1	0	0	1	0	TRACK-OFFSET ADJUSTMENT START		
1	0	0	1	0	0	1	1	TRACK-OFFSET ADJUSTMENT OFF	○	
1	0	0	1	0	1	0	0	LASER ON: F-SERVO ON		
1	0	0	1	0	1	0	1	LASER OFF: F-SERVO ON		
1	0	0	1	0	1	1	0	LASER OFF: F-SERVO OFF	○	
1	0	0	1	0	1	1	1	SPINDLE 8CM		
1	0	0	1	1	0	0	0	SPINDLE 12CM	○	
1	0	0	1	1	0	0	1	SPINDLE OFF		
1	0	0	1	1	0	1	0	SLED ON		
1	0	0	1	1	0	1	1	SLED OFF		
1	0	0	1	1	1	0	0	E/F BALANCE START	Adjustment not performed	
1	0	0	1	1	1	0	1	TRACK-SERVO OFF		
1	0	0	1	1	1	1	0	TRACK-SERVO ON		

Notes on Microcontroller Software Implementation

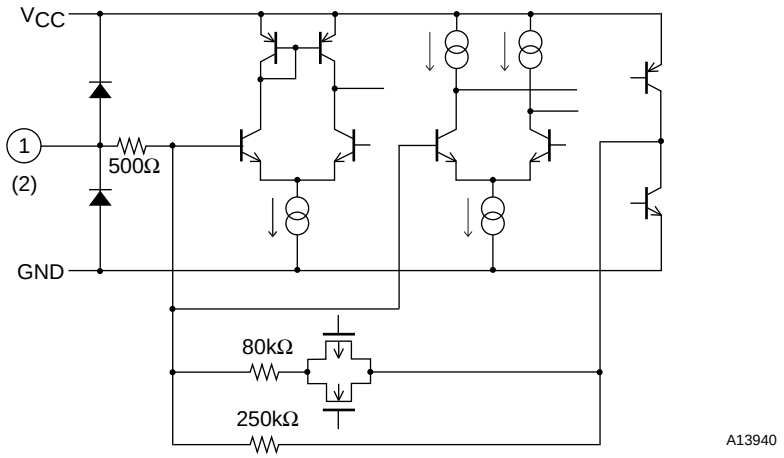
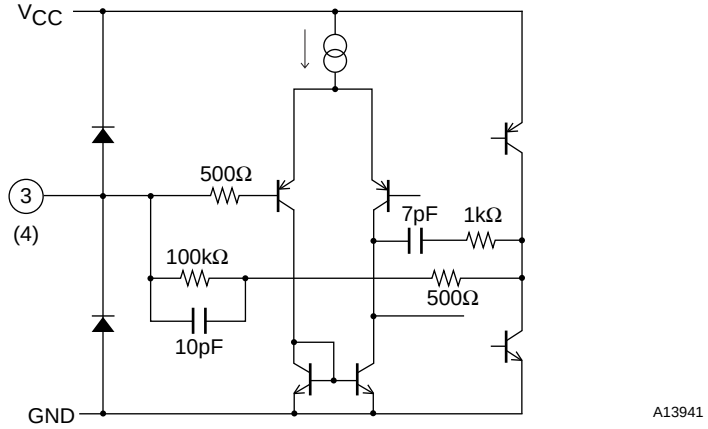
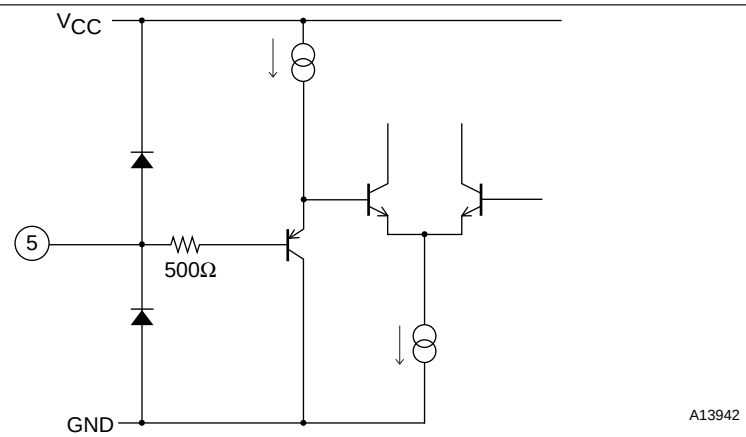
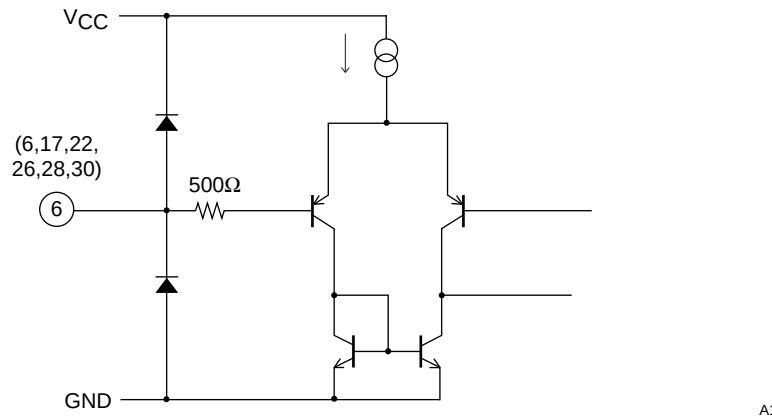
- Command relationships
  Since the IC internal registers are cleared after either a FOCUS START or an E/F BALANCE START command is issued, applications must issue a 11111110 (= FEh (hexadecimal)) command after either of those commands.
  Reason: Those two commands are executed at point (1) in the timing chart below. However, after that, if a CE signal such as that shown below is input, the data will be executed again as the same command at point (2) in the timing chart.



  When either a TRACK-OFFSET ADJUST START or a FOCUS-OFFSET ADJUST START command is issued after either a VCC ON (POWER ON RESET), RESET, or a corresponding OFFSET ADJUST OFF command, the wait time shown below is required. (Note that this applies in the state where the 130kHz clock is input.)
  TRACK-OFFSET ADJUST START: At least 4ms
  FOCUS-OFFSET ADJUST START: At least 4ms

- Notes on E/F balance adjustment
  The E/F balance adjustment must be performed not on a disc mirror area, but on a disc pit area.
  Also, since track kick operations are not performed during the EF balance adjustment, care must be taken that a stable TE signal is acquired. (For example, by performing sled advance operations from the microcontroller.)

Pin Internal Equivalent Circuits

Pin No.	Pin	Equivalent circuit
1 2	FIN2 FIN1	
3 4	E F	
5	TB	
6 17 22 26 28	TE– FD– FE– SP– SLEQ	

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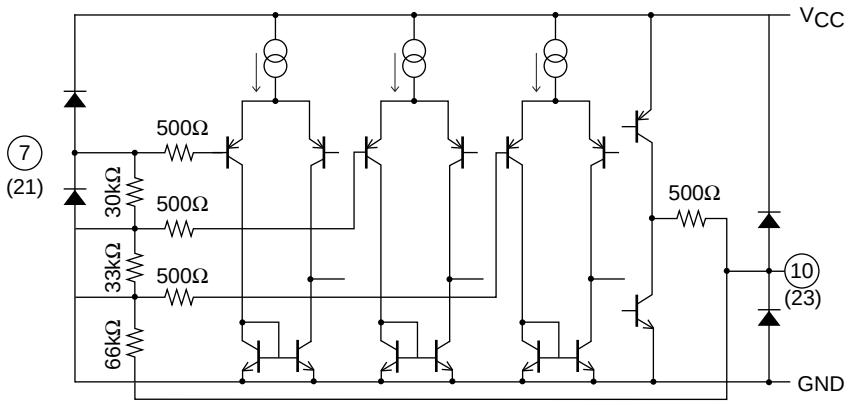
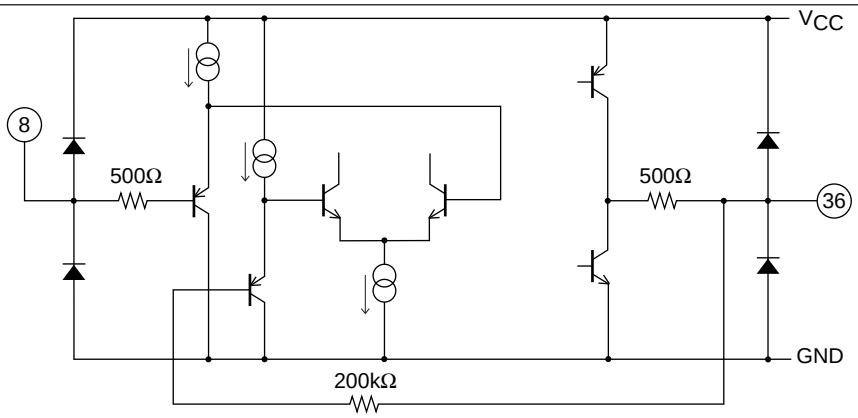
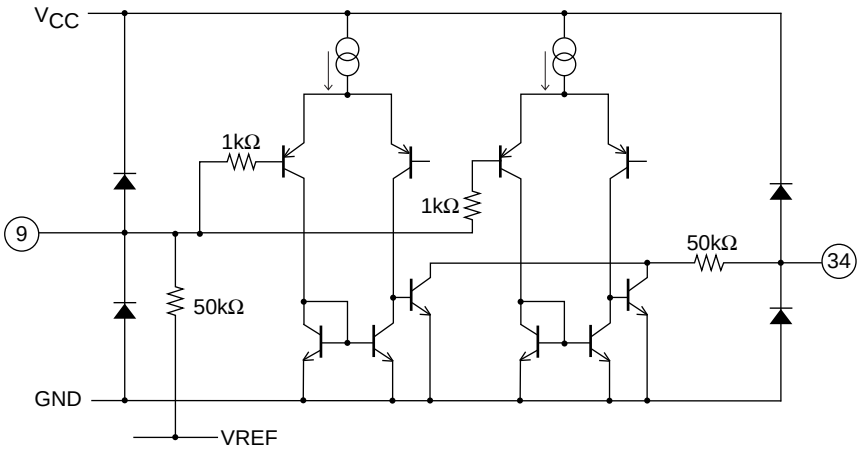
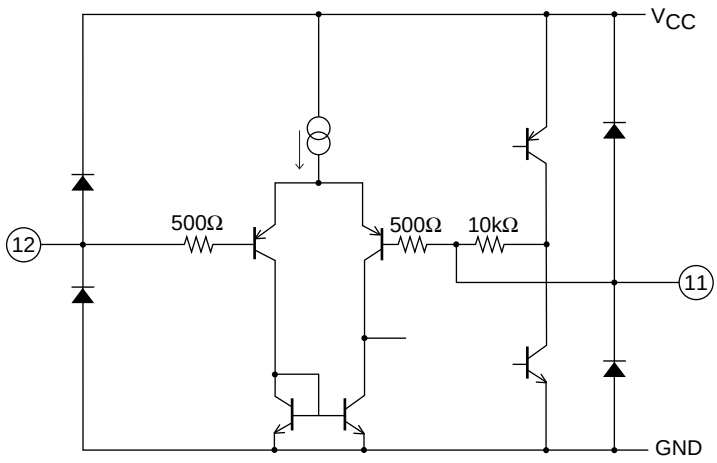
Pin No.	Pin	Equivalent circuit
7 10 21 23	TE TH FE FH	
8 36	TESI TES	
9 34	SCI TGL	
11 12	TA TD–	

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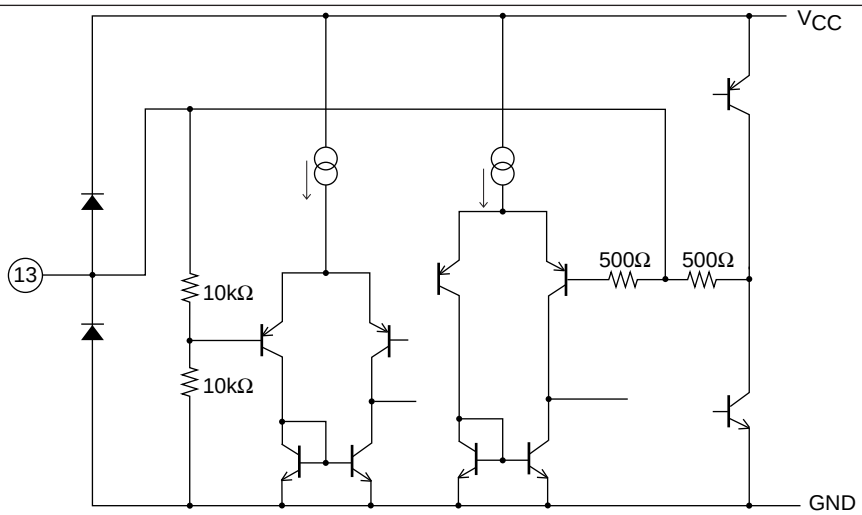
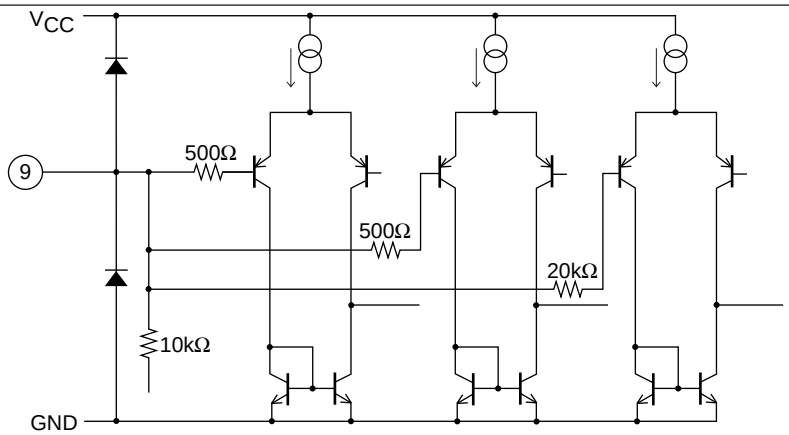
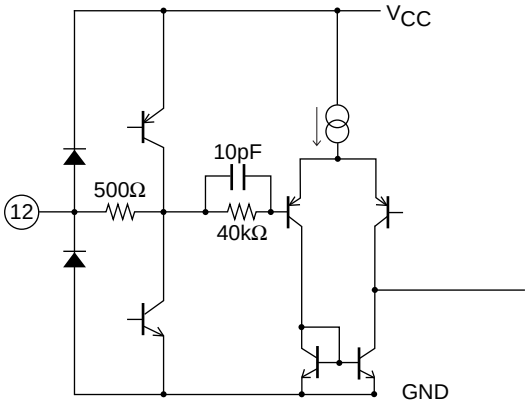
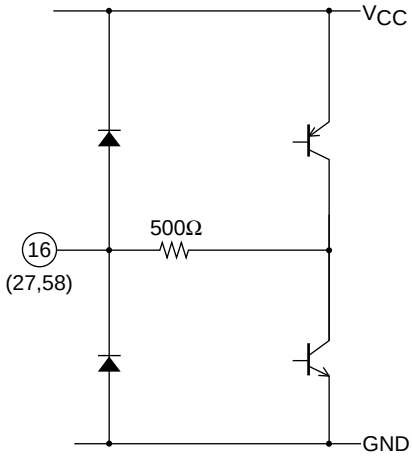
Pin No.	Pin	Equivalent circuit
13	TD	
14	JP	
15	TO	
16 27 58	FD SPD FSC	

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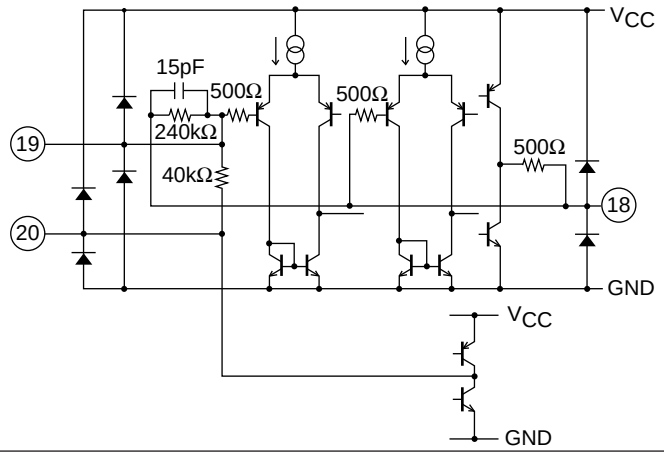
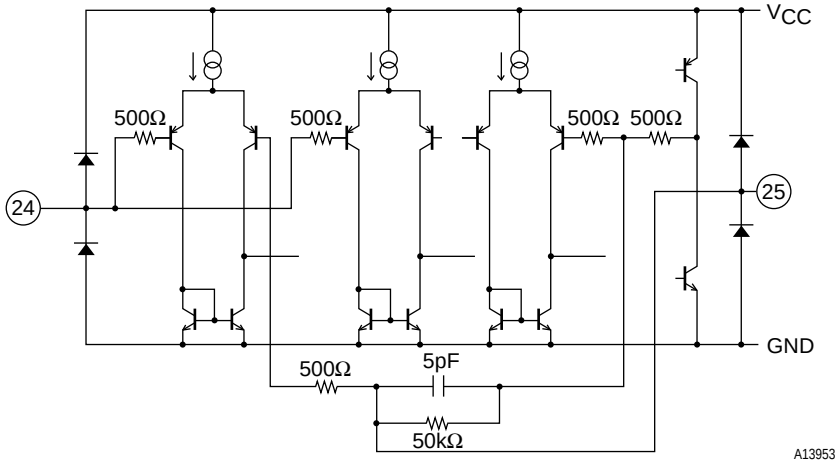
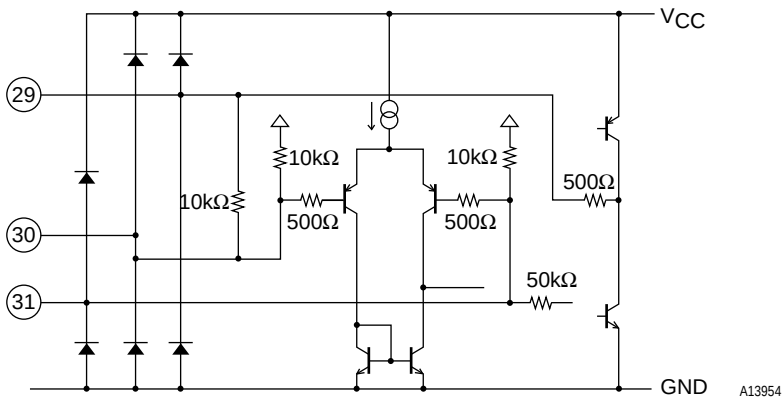
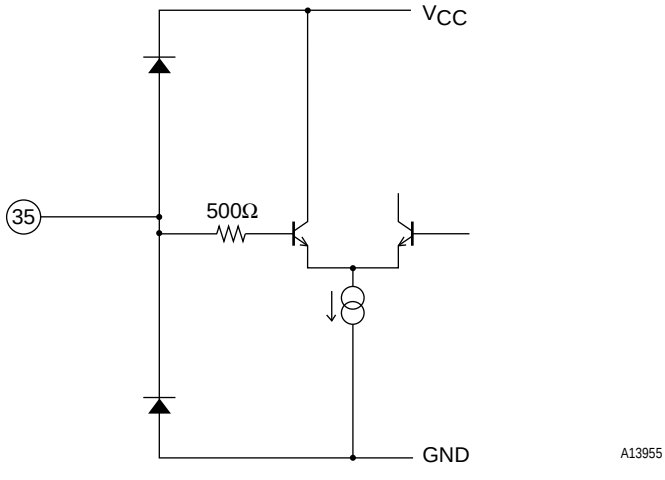
Pin No.	Pin	Equivalent circuit
18 19 20	FA FA– FHO	
24 25	SP SPG	
29 30 31	SLD SL– SL+	
35	TOFF	

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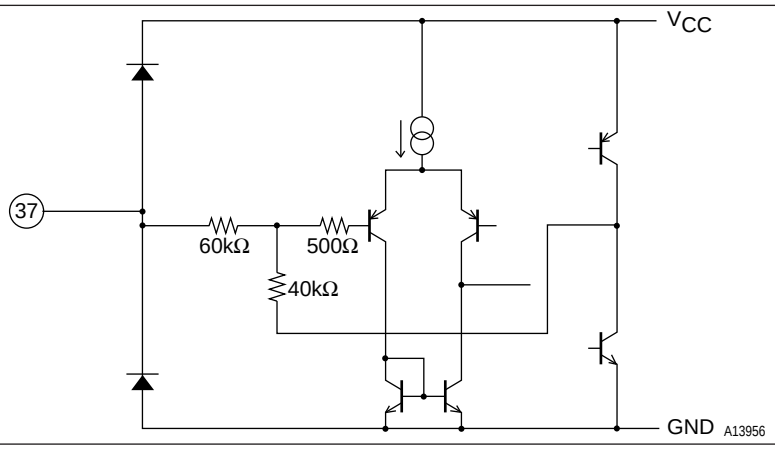
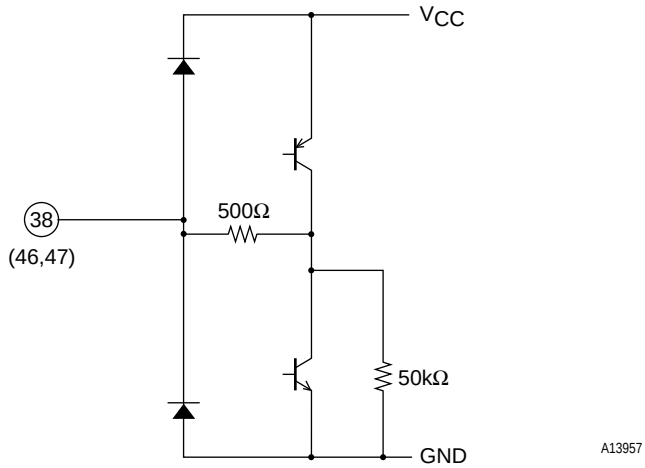
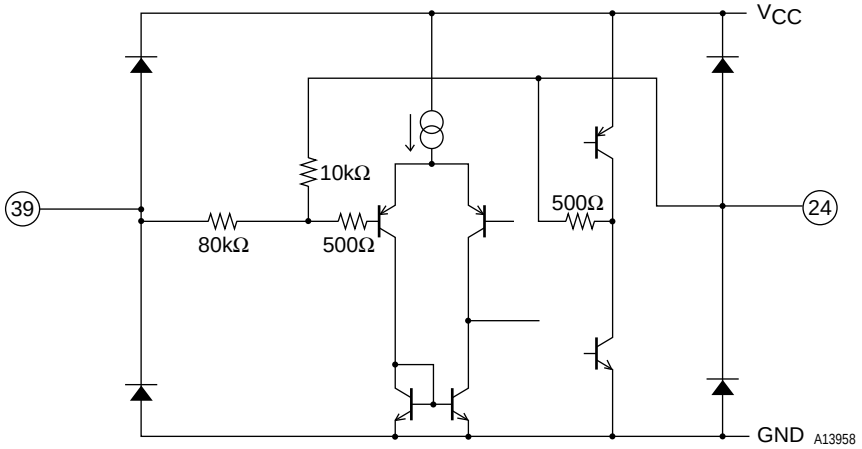
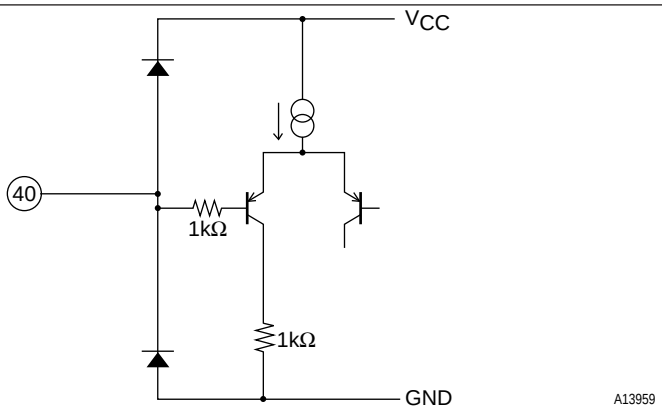
Pin No.	Pin	Equivalent circuit
37	TJP	
38 46 47	HFL DEF DRF	
39	CLV	
40	INTI	

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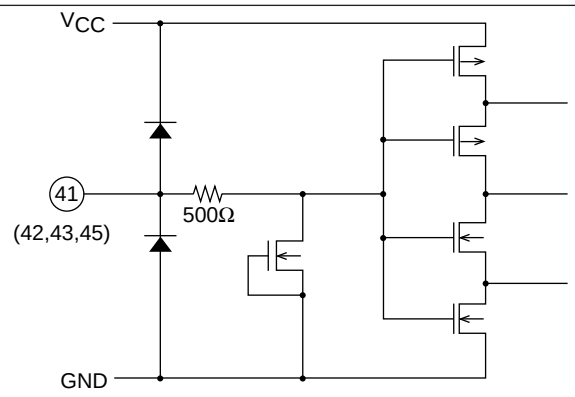
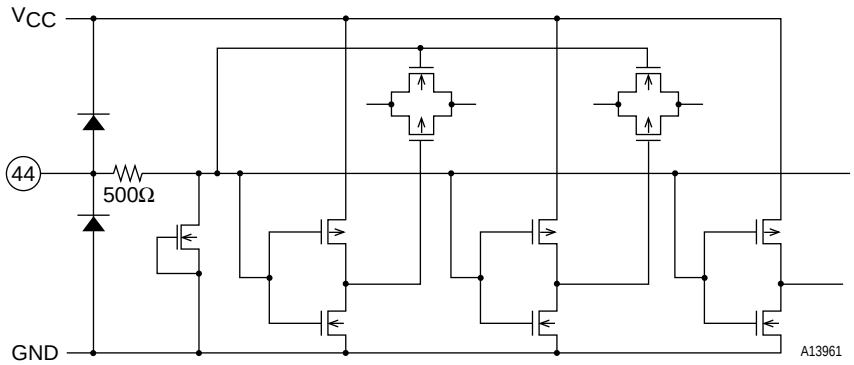
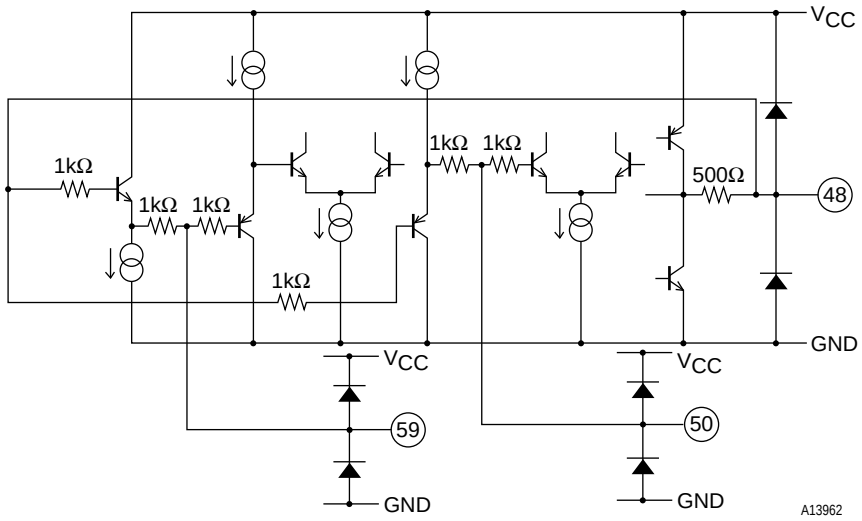
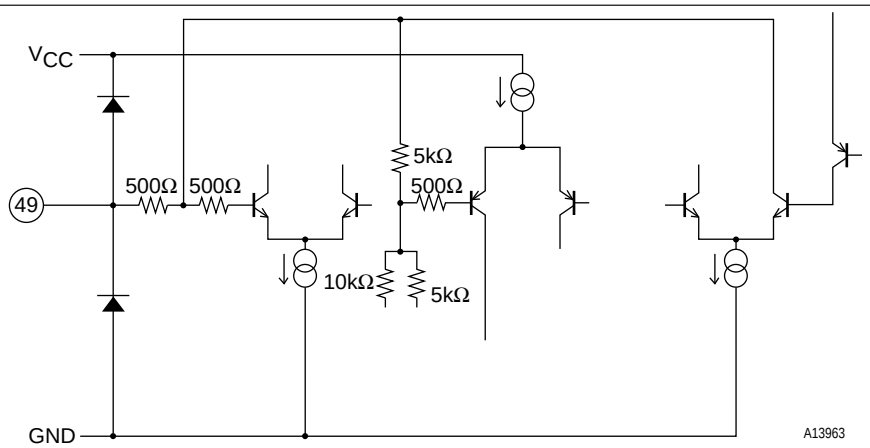
Pin No.	Pin	Equivalent circuit
41 42 43 45	CL DAT CE CLK	
44	RW	
48 50 59	RFSM PH1 BH1	
49	RF–	

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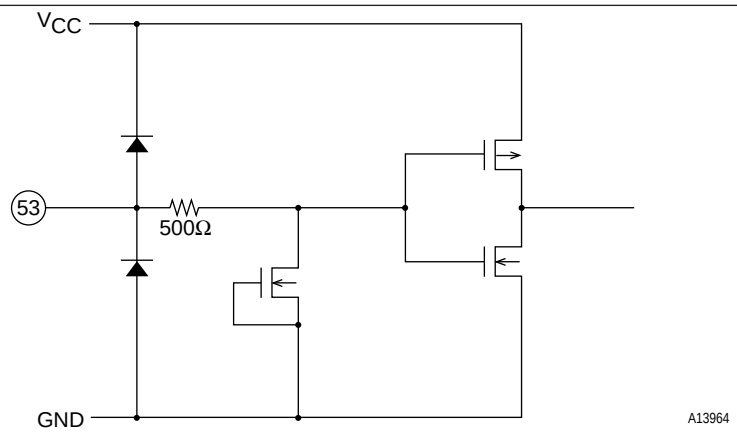
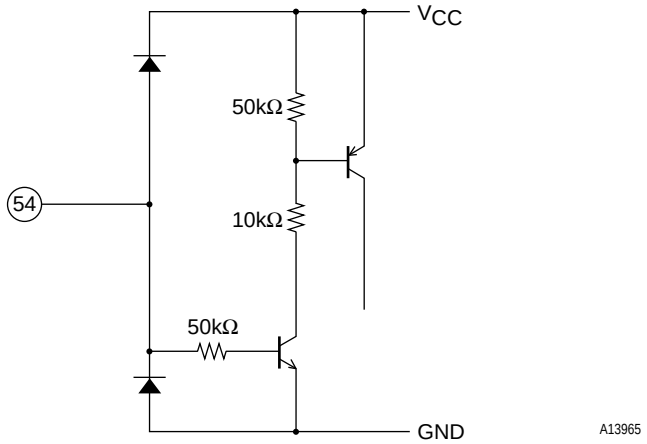
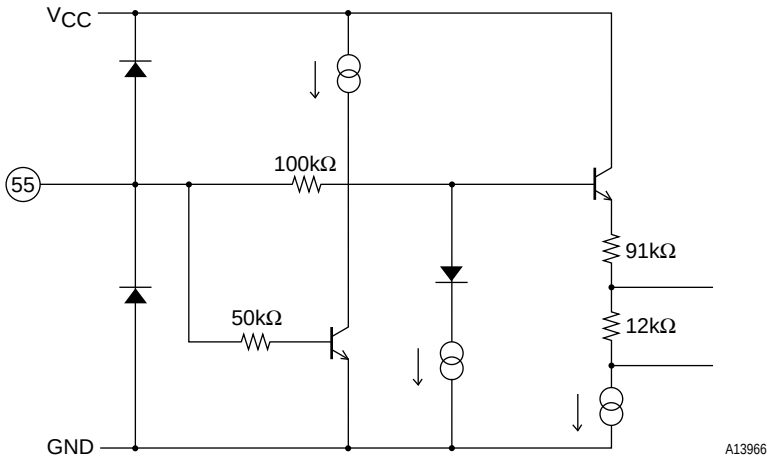
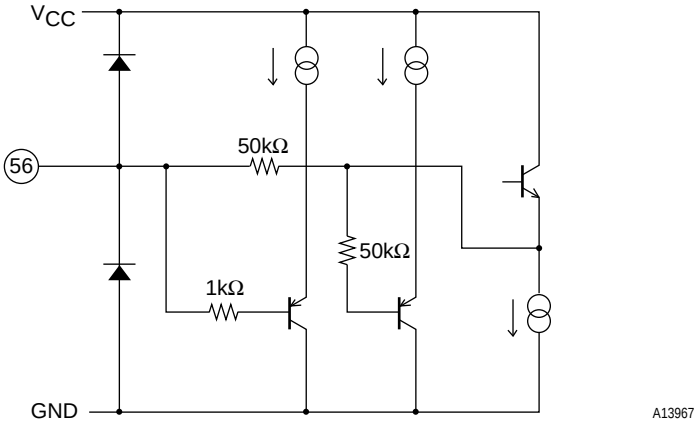
Pin No.	Pin	Equivalent circuit
53	FAJON	
54	FSS	
55	PON	
56	LF2	

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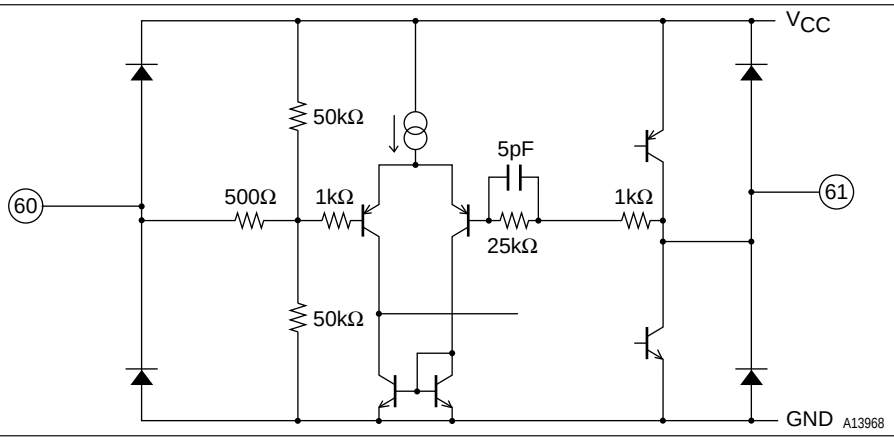
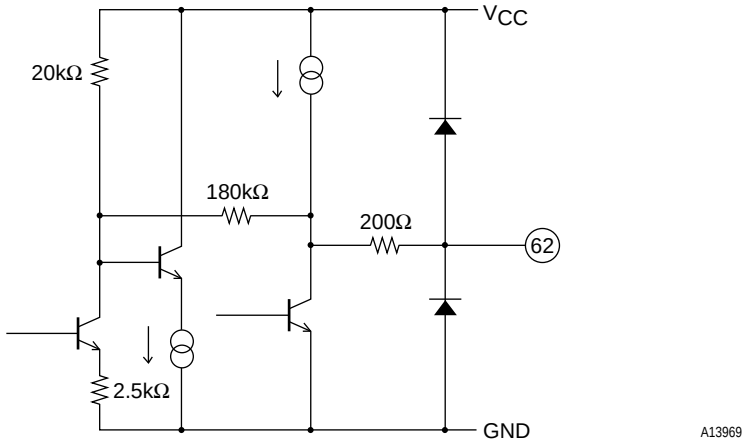
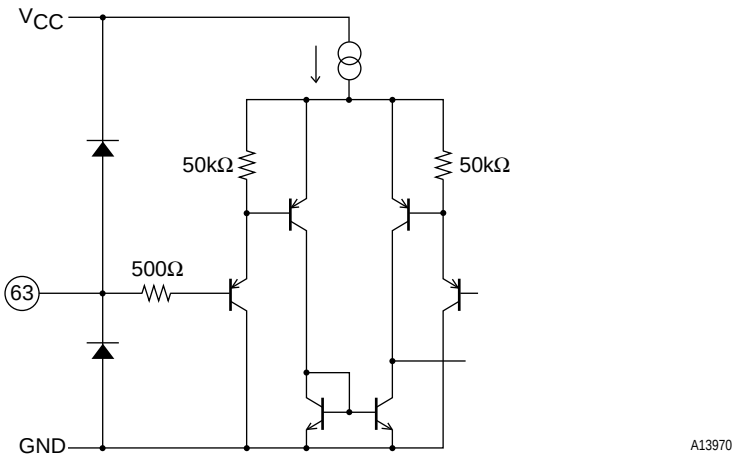
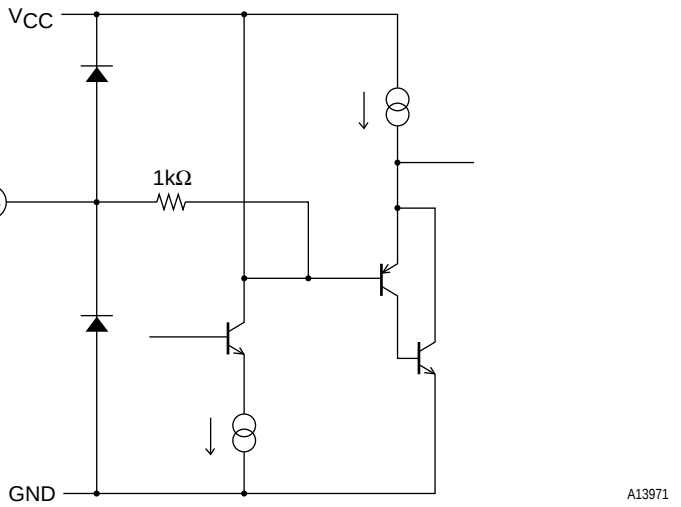
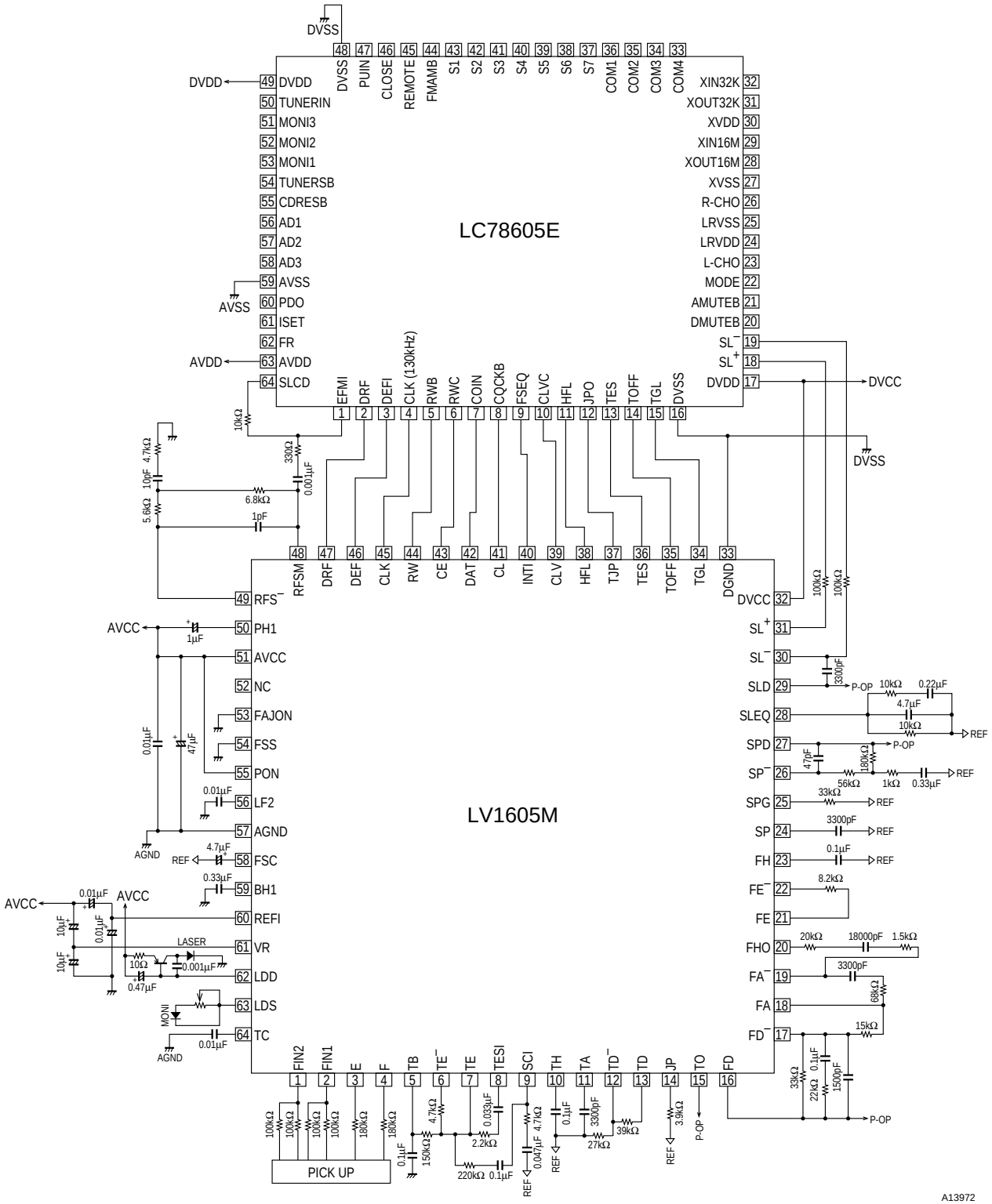
Pin No.	Pin	Equivalent circuit
60 61	REFI VR	
62	LDD	
63	LDS	
64	TC	

Application Circuit



Product	LA9230M	LA9240M	LA9241M	LA9242M	LV1605M
Package	QIP-64E	QIP-64E	QIP-64E	QIP-64E	QIP-64E
Allowable operating supply voltage V_{CC}op max V_{CC}op min1 V_{CC}op min2 Recommended supply voltage	 5.5V 3.6V: t=–25 to +75°C 5.0V	 5.5V 3.6V: t=–25 to +75°C 3.4V: t=–5 to +75°C 5.0V	 5.5V 3.2V: t=–25 to +75°C 3.0V: t=–10 to +75°C 5.0V	 5.5V 3.2V: t=–25 to +75°C 3.0V: t=–10 to +75°C 5.0V	 3.6V 3.0V: t=–10 to +75°C 3.3V
Current drain	32mA	32mA	32mA	34mA	16mA
Automatic adjustment function					
Focus offset adjustment Maximum adjustment time	Adjustment position: FD 270ms	Adjustment position: FE 30ms	Adjustment position: FE 30ms	Adjustment position: FE 30ms	Adjustment position: FE (The adjustment range is four times that of the LA9242M) 130ms
Tracking offset adjustment Maximum adjustment time	Adjustment position: TO 30ms	Adjustment position: TE 30ms	Adjustment position: TE 30ms	Adjustment position: TE 30ms	Adjustment position: TE (The adjustment range is four times that of the LA9242M) 60ms
E/F balance automatic adjustment	○	○	○	○	○
RF level AGC function RF amplitude at the recommended supply voltage RF amplitude at V_{CC}min	 1.8Vp-p 1.3Vp-p	 1.8Vp-p 1.2Vp-p: V_{CC}=3.4V	 1.5Vp-p 0.9Vp-p: V_{CC}=3.0V	 1.5Vp-p 0.9Vp-p: V_{CC}=3.0V	 1.4Vp-p 1.3Vp-p: V_{CC}=3.0V
RF hold on disc defect detection	×	×	×	×	○
Tracking servo gain RF level following function	○	○	○	○	○
Focus servo gain RF level following function	×	×	×	×	○
Focus search time	About 280ms	About 560ms	About 560ms	About 560ms	About 560ms
Playback speed	2 ×	4 ×	4 ×	4 × (normal mode)	4 ×
Tracking signal output (Track kick during E/F balance adjustment)	Built in	No output provided	No output provided	No output provided	No output provided
Focus search smoothing capacitor pin: FSC	×	○	○	○	○
E/F balance setting range adjustment pin: TBC	×	○	○	○	×
Focus search mode switching pin: FSS	×	○	○	○	○
HFL detection Vth	2.3V	2.1V	2.1V	2.1V	1.47V
DRF current capacity	About 100µA	About 250µA	About 250µA	About 250µA	About 100µA
APC reference voltage The LCD voltage such that LDD=3V	180mV: typ	180mV: typ	190mV: typ	190mV: typ	170mV: typ (The LDS voltage such that LDD=1.65V)
No connect pins	Pins 46, 47, 48, and 55	Pin 48	Pins 23 and 48	Pins 23 and 48	Pin 52
RW disc playback support	×	×	×	○	○
Hold function for focus, spindle, and sled servos during disc defect detection	×	×	×	×	○
Tracking hold function during disc defect detection	○	○	○	○	○