

MOTOROLA
SEMICONDUCTOR
 TECHNICAL DATA

MC13024

Advance Information

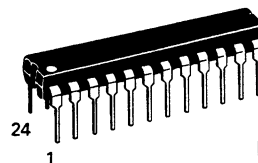
**LOW VOLTAGE MOTOROLA C-QUAM®
 AM STEREO RECEIVER**

The MC13024 is intended to serve the manually tuned portable and pocket radio mass market. This part includes all receiver and stereo decoding functions, from antenna to Left and Right audio outputs.

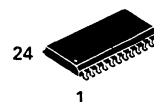
- Full Operation from 1.8 V to 8.0 Vdc Supply
- Low Power, Current Drain (typ) 5.0 mA
- Typical Distortion <1% at 90% L+R or 50% Single Channel
- Typical Channel Separation >25 dB
- Pilot Tone Detector
- Combined Two Level Tuning and Stereo Indicator
- "Blend On" Stereo Mode
- High Accuracy, Fast Locking VCLO
- Controlled Return to Monaural Under Adverse Conditions
- Minimized "Tweets and Birdies"
- Minimized Tuning Transients

**LOW VOLTAGE
 MOTOROLA C-QUAM®
 AM STEREO RECEIVER**

**SILICON MONOLITHIC
 INTEGRATED CIRCUIT**

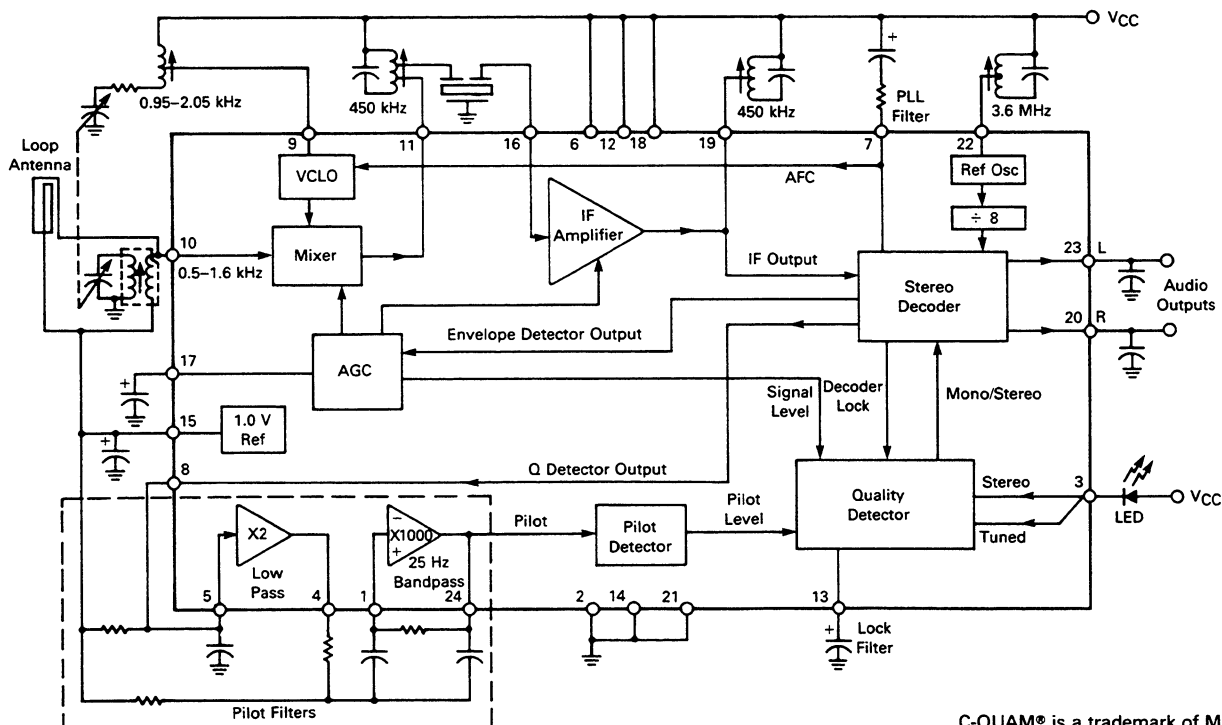


P SUFFIX
 PLASTIC PACKAGE
 CASE 724



DW SUFFIX
 PLASTIC PACKAGE
 CASE 751E
 (SO-24L)

FIGURE 1 — FUNCTIONAL BLOCK DIAGRAM



C-QUAM® is a trademark of Motorola.

MAXIMUM RATINGS ($T_A = 25^\circ\text{C}$ unless otherwise noted)

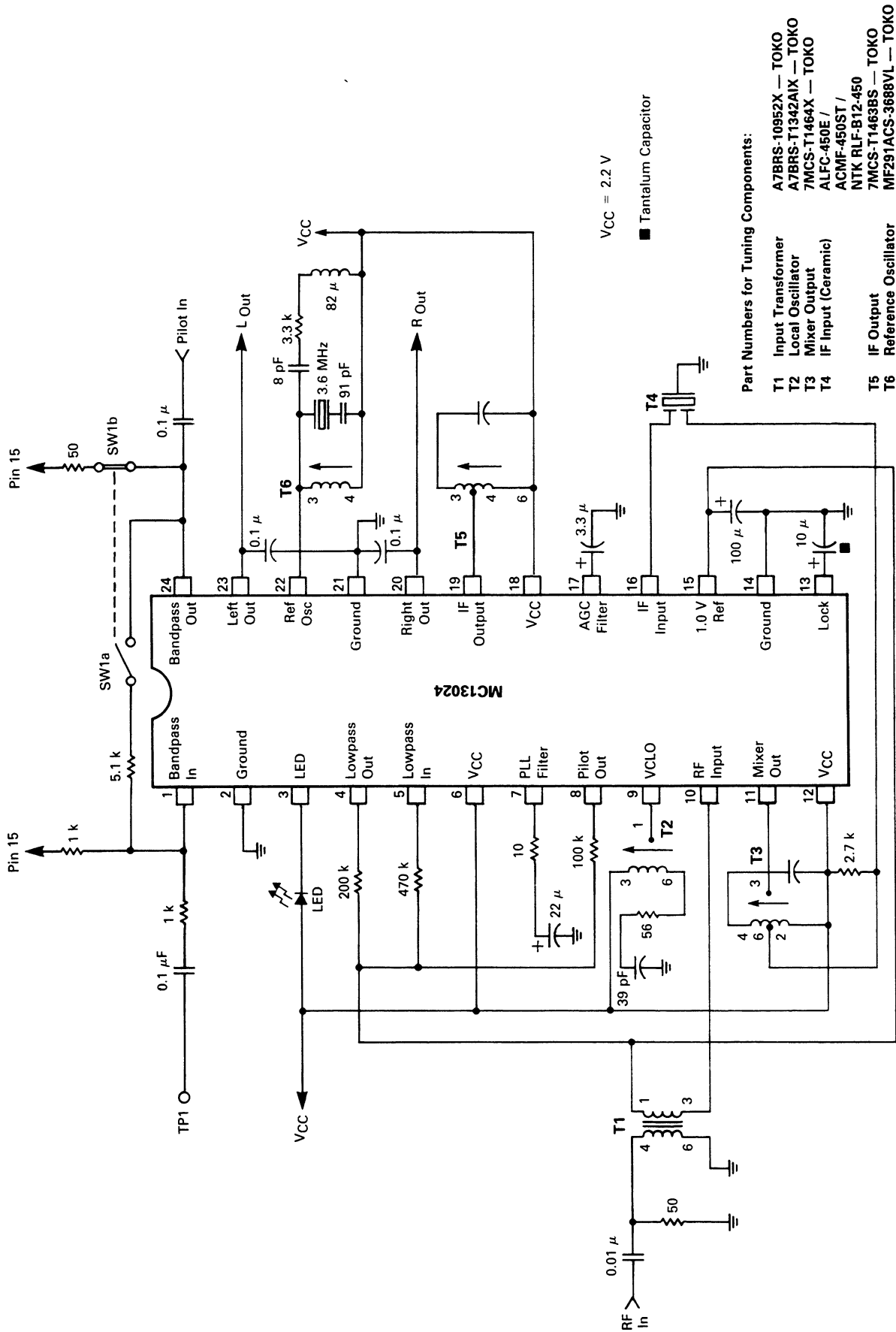
Rating	Symbol	Value	Unit
Supply Voltage	V_{CC}	10	Vdc
Operating Temperature	T_A	0 to +70	$^\circ\text{C}$
Storage Temperature	T_{stg}	-65 to +150	$^\circ\text{C}$

ELECTRICAL CHARACTERISTICS ($V_{CC} = 2.2 \text{ Vdc}$, $T_A = 25^\circ\text{C}$, Input RF signal = 40 dB μV at 1.0 MHz directly fed to the receiver, Modulating signal = 1.0 kHz sine wave at 30% modulation, unless otherwise noted.)

Characteristic		Min	Typ	Max	Unit
Power Supply Voltage		—	1.8 to 8.0	—	Vdc
Supply Current, Excluding Current LEDs					mA
No Signal		4.0	5.4	6.5	
Monaural		5.0	6.0	6.8	
Stereo		5.0	6.0	6.8	
LED Driving Current					mA
Monaural		0.8	1.2	1.8	
Stereo		2.5	4.0	5.5	
Sensitivity, Monaural					μV
Maximum		—	5.0	—	
20 dB S/N		—	8.0	—	
S/N Ratio	Monaural	30	38	—	dB
	Stereo	28	34	—	
Channel Separation	L to R	17	25	—	dB
	R to L	17	25	—	
Recovered Audio (L or R)		9.0	13	16	mVRMS
Stereo Channel Balance		—	-32	—	dB
Distortion	Monaural	—	0.9	1.3	%
	Stereo	—	1.1	2.5	

NOTE: 1. A 200 Hz high-pass filter is required at the recovered audio output to filter out the residual 25 Hz pilot frequency.

FIGURE 2 — MC13024 TEST CIRCUIT SCHEMATIC



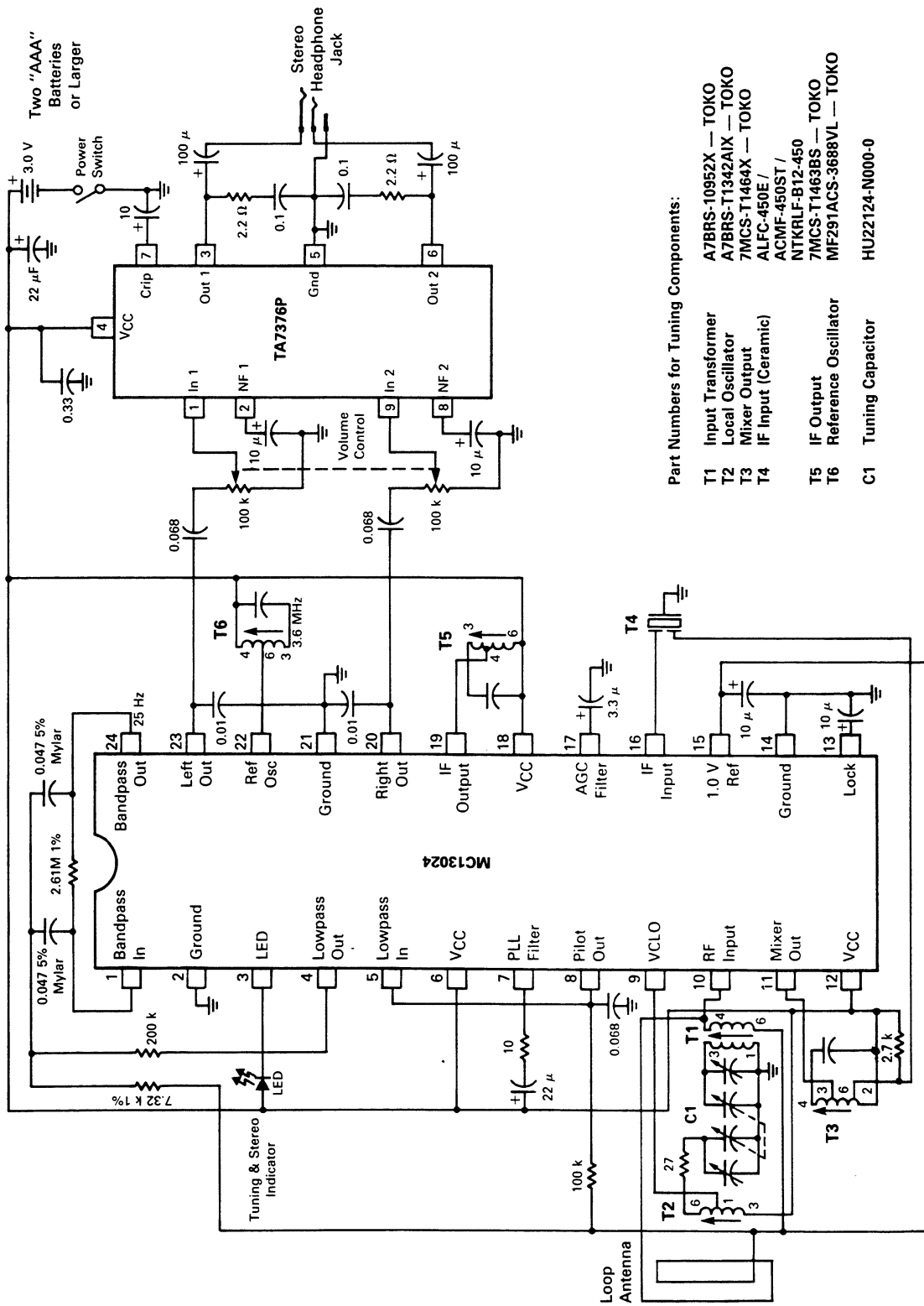
VCC = 2.2 V

■ Tantalum Capacitor

Part Numbers for Tuning Components:

- T1 Input Transformer — TOKO A7BRS-10952X
- T2 Local Oscillator — TOKO A7BRS-T1342AIX
- T3 Mixer Output — TOKO 7MCS-T1464X
- T4 IF Input (Ceramic) — ALFC-450E / ACMF-450ST / NTK RLF-B12-450
- T5 IF Output — TOKO 7MCS-T1463BS
- T6 Reference Oscillator — TOKO MF291ACS-3688VL

FIGURE 3 — APPLICATION CIRCUIT, MANUALLY TUNED HEADPHONE RADIO



Part Numbers for Tuning Components:

- | | | |
|----|----------------------|---|
| T1 | Input Transformer | A7BRS-10952X — TOKO |
| T2 | Local Oscillator | A7BRS-T1342AIX — TOKO |
| T3 | Mixer Output | 7MCS-T1464X — TOKO |
| T4 | IF Input (Ceramic) | ALFC-450E /
ACMF-450ST /
NTKRLF-B12-450 |
| T5 | IF Output | 7MCS-T1463BS — TOKO |
| T6 | Reference Oscillator | MF291ACS-3688VL — TOKO |
| C1 | Tuning Capacitor | HU22124-N000-0 |

GENERAL DESCRIPTION

The MC13024 is a complete C-QUAM® AM stereo receiver, from the antenna to low level audio. All that is needed make a complete AM stereo radio is the addition of the appropriate audio output amplifier. The MC13024 is intended for use in most types of manually tuned receivers: pocket portables, "boom boxes," table radios, etc. It will operate from 1.8 Vdc to 8.0 Vdc and requires typically 5.0 mA (not including LED). This broad supply voltage tolerance and low power consumption makes it ideal for portables using as few as 2 battery cells. The radios which can be built using this part can be quite low in cost, while still benefiting from a high degree of functional sophistication.

FEATURES

The MC13024 contains a wide dynamic range mixer, IF, AGC, AFC, C-QUAM® decoder, stereo pilot tone detector, and a signal quality detector. The stereo decoding and pilot detection are similar to the well-established MC13020, except for reduced peripheral components, and the phase-locked loop used for the L-R detection now is looped around the entire receiver. In other words, the PLL controls the tuner local oscillator (VCLO) rather than a detector loop after the IF. The advantage of this, in manually tuned AM stereo, is significant, because it assures that the signal will always be properly centered in the IF bandpass, which is critical to good channel separation. This architecture also gives the radio an AFC tuning behavior which makes it easy to tune. The PLL has two "speeds," provided by current ratios of 50:1, which give fast lock and low distortion, respectively.

A signal quality detector circuit monitors lock condition, excess in-phase modulation due to interference, pilot presence and amplitude, and the movement of the

tuning element by the user. A proper level of pilot must be present for several cycles before stereo mode will be enabled. When all conditions are correct, the transition from monaural to stereo is done gradually to prevent a transient "pop." Under aberrated conditions, the audio may either blend to mono or make an immediate change to mono, depending on the detected condition. The LED pin drives a dual purpose indicator: low current for PLL lock, and full current for stereo mode. Again, the switching is done "softly" to prevent transient loading of a weak battery.

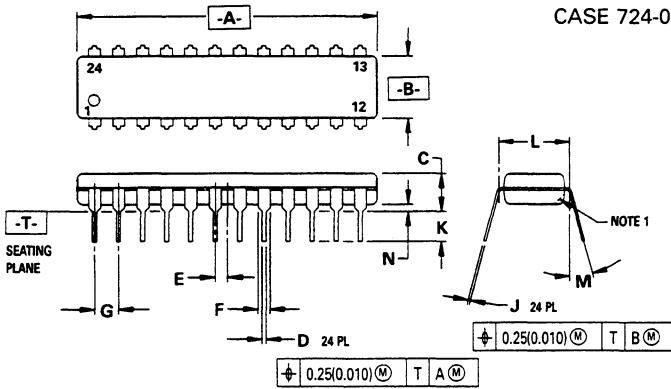
The IF gain and the mixer RF gain are each reduced, in turn, as signal strength increases, to optimize S/N and prevent overload. The receiver is capable of 20 dB S/N at 2.5 μ V/50 ohm input. At weak signals, the reference oscillator and quadrature divider are shut off to minimize "tweets and birdies."

RADIO CONSTRUCTION

Layout is not much more critical than any high performance AM receiver. Care must be taken to provide a good ground plane and short leads on signal paths. Take special care to keep the reference oscillator components close to Pin 22 and protected from coupling from the pilot bandpass output, Pin 24. Also take care with the ever present threat of RF radiation from the audio output back into the antenna. This can be controlled by proper component location and good (close) RF bypass on the amplifier V_{CC} and good snubbers on the audio outputs. Keeping in mind that this is a phase-detecting receiver, it is important to mount coils securely and avoid movable wires in tuned circuits. A lot of individual preference will go into each implementation; the components shown here are only intended to provide a good working start.

OUTLINE DIMENSIONS

P SUFFIX PLASTIC PACKAGE CASE 724-03

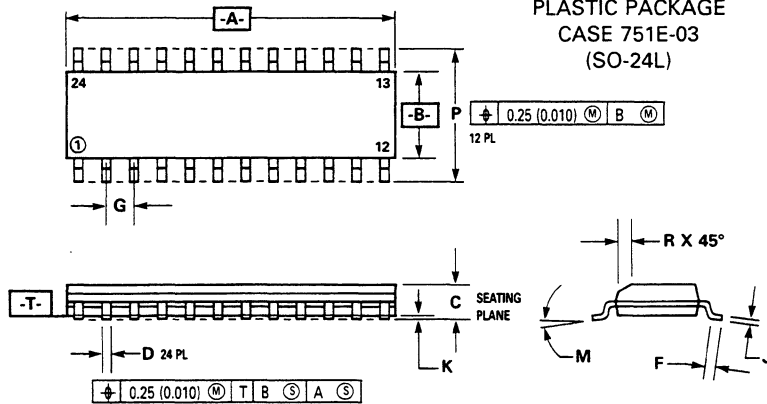


NOTES:

1. CHAMFERED CONTOUR OPTIONAL.
2. DIM "L" TO CENTER OF LEADS WHEN FORMED PARALLEL.
3. DIMENSIONS AND TOLERANCES PER ANSI Y14.5M, 1982.
4. CONTROLLING DIMENSION: INCH.

DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	31.25	32.13	1.230	1.265
B	6.35	6.85	0.250	0.270
C	3.69	4.44	0.145	0.175
D	0.38	0.51	0.015	0.020
E	1.27 BSC		0.050 BSC	
F	1.02	1.52	0.040	0.060
G	2.54 BSC		0.100 BSC	
J	0.18	0.30	0.007	0.012
K	2.80	3.55	0.110	0.140
L	7.62 BSC		0.300 BSC	
M	0°	15°	0°	15°
N	0.51	1.01	0.020	0.040

DW SUFFIX PLASTIC PACKAGE CASE 751E-03 (SO-24L)



NOTES:

1. DIMENSIONS A AND B ARE DATUMS AND T IS A DATUM SURFACE.
2. DIMENSIONING AND TOLERANCING PER ANSI Y14.5M, 1982.
3. CONTROLLING DIMENSION: MILLIMETER.
4. DIMENSION A AND B DO NOT INCLUDE MOLD PROTRUSION.
5. MAXIMUM MOLD PROTRUSION 0.15 (0.006) PER SIDE.


DIM	MILLIMETERS		INCHES	
	MIN	MAX	MIN	MAX
A	15.25	15.54	0.601	0.612
B	7.40	7.60	0.292	0.299
C	2.35	2.65	0.093	0.104
D	0.35	0.49	0.014	0.019
F	0.41	0.90	0.016	0.035
G	1.27 BSC		0.050 BSC	
J	0.229	0.317	0.0090	0.0125
K	0.127	0.292	0.0050	0.0115
M	0°	8°	0°	8°
P	10.05	10.55	0.395	0.415
R	0.25	0.75	0.010	0.029



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MC13024/D

